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Tests of Reinforced Concrete Beams:

Effect of Age Uqon Modulus of Elasticity

Civil Engineering

C. E.

1907

TESTS OF REINFORCED CONCRETE BEAMS:
EFFECT OF AGE UPON MODULUS OF ELASTICITY

BY

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THESIS

FOR

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

PRESENTED JUNE, 1907

C O L L E G E   O F   E N G I N E E R I N G

May 24, 1907.

This is to certify that the following thesis prepared under the direction of Professor A. N. Talbot, Head of the Department of Municipal and Sanitary Engineering, by

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entitled TESTS OF REINFORCED CONCRETE BEAMS: EFFECT OF AGE UPON MODULUS OF ELASTICITY

is accepted by me as fulfilling this part of the requirements for the Degree of Bachelor of Science in Civil Engineering.

Ira O. Baker

Head of Department of Civil Engineering

TESTS OF REINFORCED CONCRETE BEAMS.

EFFECT OF AGE UPON THE MODULUS OF ELASTICITY.

INTRODUCTION.

INTRODUCTION.

Inasmuch as reinforced concrete is coming into very great favor as a substitute for steel and masonry,any series of experiments tending to establish data concerning the properties of this new building material will be of great benefit to all engineers and architects.

During the previous years tests have been made at the University of Illinois to determine,1;-the general action of beams during the progress of loading,and their final failure:2;-the deformations and the stresses in the steel reinforcement,and the deformations in the concrete as well as the conditions at the maximum load taken by the beam:3;-the effect of the form of the reinforcing bars,and the effect of the amount of reinforcement: and 4;-the position of the neutral axis and the measure of the resisting moment of the beam.In these former tests the loads were added continuously in some cases,and in others were released at partial loading and then reapplied.

The object of this thesis is to determine the effect of age upon the modulus of elasticity of the concrete. Twenty-eight beams were considered,of the same dimensions,varying only in mixture and age. The mixtures used were 1-1-2,1-2-4 and 1-4-8. This gave a comparison between a lean,normal and rich concrete. The beams were all in the 300.series. The numbers denoting the kind of cement in each beam were suffixed as a decimal to the ordinary beam number:those numbered from 1-4 inclusive were made of Chicago AA Portland Cement and those numbered from 5-9 inclusive were made of Universal Portland Cement. In the 1-1-2 and 1-4-8 series tests were made at 7 and

14 days:in the 1-2-4 series tests were made at 4,7,14,24 and 60 days. Deflections at the center were taken,and also extensometer readings from which were computed the deformations and stresses in the concrete and in the steel. Curves showing the unit deformations in the steel and in the concrete,the position of the neutral axis and the deflections at the center of the beam were plotted. Then the modulus of elasticity for the different beams was determined. The details,computations and results of the tests will be taken up separately in the following pages.

PART 1.
MATERIALS.

PART I.MATERIALS.

All of the materials were purchased in the open market,so as to be able to use the materials that are ordinarily used in concrete work.It is necessary to do this in order that the tests might be of practical value in construction work.

Stone;-The stone used was Kankakee limestone,ordered screened through a 1 in. and over a 1/4 in. screen.Experiment showed that there was 43.8 % voids in the stone.In determining this the stone was placed in a bucket and then water was poured in until the bucket was full:the ratio of the amount of water necessary to fill the voids to the amount of water the bucket will hold gives the percent of voids.Table 32,page 7,shows the results of the fineness tests of the stone.

Sand;-The sand came from near the Wabash river at Attica, Indiana,and while not very sharp,it was fairly clean and of good quality.The result of the determination of the voids,by the same method as that used in the determination of voids in the stone, showed 32.6 % of voids.Table 33,page 7 ,shows the results of the fineness tests of the sand.

Cement;-Universal Portland Cement was used in a part of the beams and Chicago AA Portland Cement was used in the remainder of the beams.The tables in Part V111,pages 84-111show the kind of cement used in each beam. Table 34,page 8 ,gives the tensile strength of Universal Portland Cement,neat and in a 1-3 mortar. Table 35,page 8 ,gives the fineness tests for the same cement. Table 36,page 9 ,gives the tensile strength of Chicago AA Portland Cement,neat and in a 1-3 mortar,and Table 37,page 9 ,the

Table 32.

Mechanical Analysis of Stone.

Mesh in inches.	Percent Passing.	
	First Trial.	Second Trial.
2.	100.0	100.0
$1\frac{1}{4}$.	95.8	92.6
1.	82.5	65.0
$\frac{1}{2}$.	9.3	2.6
$\frac{1}{4}$.	1.9	0.9
$\frac{1}{8}$.	1.0	0.7

Table 33.

Mechanical Analysis of Sand.

Sieve Number.	Percent Passing.
5.	98.5
10.	74.3
12.	65.5
16.	56.1
18.	43.0
30.	27.3
40.	17.9
50.	12.5
74.	5.6
150.	1.4
200.	1.1

Table 34.

Tensile Strength of Universal Portland Cement.

Ref. No.	Ultimate Strength: lbs. per. sq. in.			
	Age - 7 Days.		Age - 28 Days.	
	Neat.	1-3 Mortar.	Neat.	1-3 Mortar.
1.	560.	185.	585.	320.
2.	450.	165.	660.	250.
3.	500.	190.	655.	295.
4.	460.	185.	705.	255.
5.	545.	175.	665.	260.
6.	520.	200.	605.	315.
Average.	506.	183.	646.	282.

Table 35.

Fineness Test of Universal Portland Cement.

Sieve No.	Percent Passing.
74.	98.65
100.	96.20
200.	80.95

Table 36.

Tensile Strength of Chicago AA Portland Cement.

Ref. No.	Ultimate Strength in lbs. per. sq. in.			
	Age: 7 Days.		Age: 28 Days.	
	Neat.	1-3 Mortar.	Neat.	1-3 Mortar.
1.	810.	130.	865.	230.
2.	755.	120.	800.	195.
3.	780.	135.	980.	215.
4.	730.	115.	1050.	205.
5.	660.	130.	790.	180.
6.	520.	110.	685.	—
Average.	706.	123.	861.	205.

Table 37.

Fineness Test of Chicago AA Portland Cement.

Sieve No.	Percent Passing.
74.	95.8
100.	89.2
200.	66.9

fineness tests for the same cement. All of the briquettes were stored in damp air for one day, and under water for the remainder of the time.

Steel;-The bars used for reinforcing the beams were 1/2 in. in diameter, furnished by the Illinois Steel Co. The material used was mild steel having a yield point of 38500. lb. per sq. in. The percent elongation in 8 in. of length was 29.8 Table 31, page 11, gives the percent elongation in 8 in. of length, the yield point and the ultimate strength in lb. per sq. in. for the steel used in three of the beams. These values may be taken as representative.

Concrete;-The concrete was of good quality, being mixed by men who have had considerable experience in concrete work. Three mixtures were used;-

1-1-2 for the beams in series 316 and 317;

1-2-4 for the beams in series 311, 312 313, 314 and 315; and

1-4-8 for the beams in series 318 and 319.

The modulus of rupture for the same mixture of concrete, without reinforcement, was found by Mr. Richardson at the University of Illinois, and reported by him in his Thesis on The Flexural Strength of Concrete, presented June 1907. For the values of the modulus of rupture see Table 38, page 12.

Table 31.

Tension Tests of Mild Steel.

Beam.	Nominal Diam. in inches.	Yield Point. lb. per sq. in.	Ultimate Strength lb. per sq. in.	Elongation. % in 8 inches.
313.6	½	37700.	54700.	26.
	"	37600.	49000.	31.
	"	35600.	50000.	30.
	"	38900.	55600.	30.
317.5	½	38000.	58000.	27.
	"	38600.	52700.	31.
	"	45500.	58900.	31.
322.5	½	39700.	55500.	32.
	"	36200.	50500.	32.
	"	36600.	53000.	30.
	"	36200.	52000.	28.

Table 38.

Table giving modulus of rupture.

Cement used. Portland.	Mixture.	Age.	Modulus. lb. per sq. in.
Universal.	1-1-2.	7.	238.
		14.	257.
		60.	427.
	1-2-4.	7.	109.
		14.	173.
		60.	315.
	1-4-8.	7.	103.
		14.	189.
		60.	138.
Chicago AA.	1-1-2.	7.	---
		14.	204.
		60.	258.
	1-2-4.	7.	---
		14.	---
		60.	296.
	1-4-8.	7.	---
		14.	---
		60.	169.

PART II.

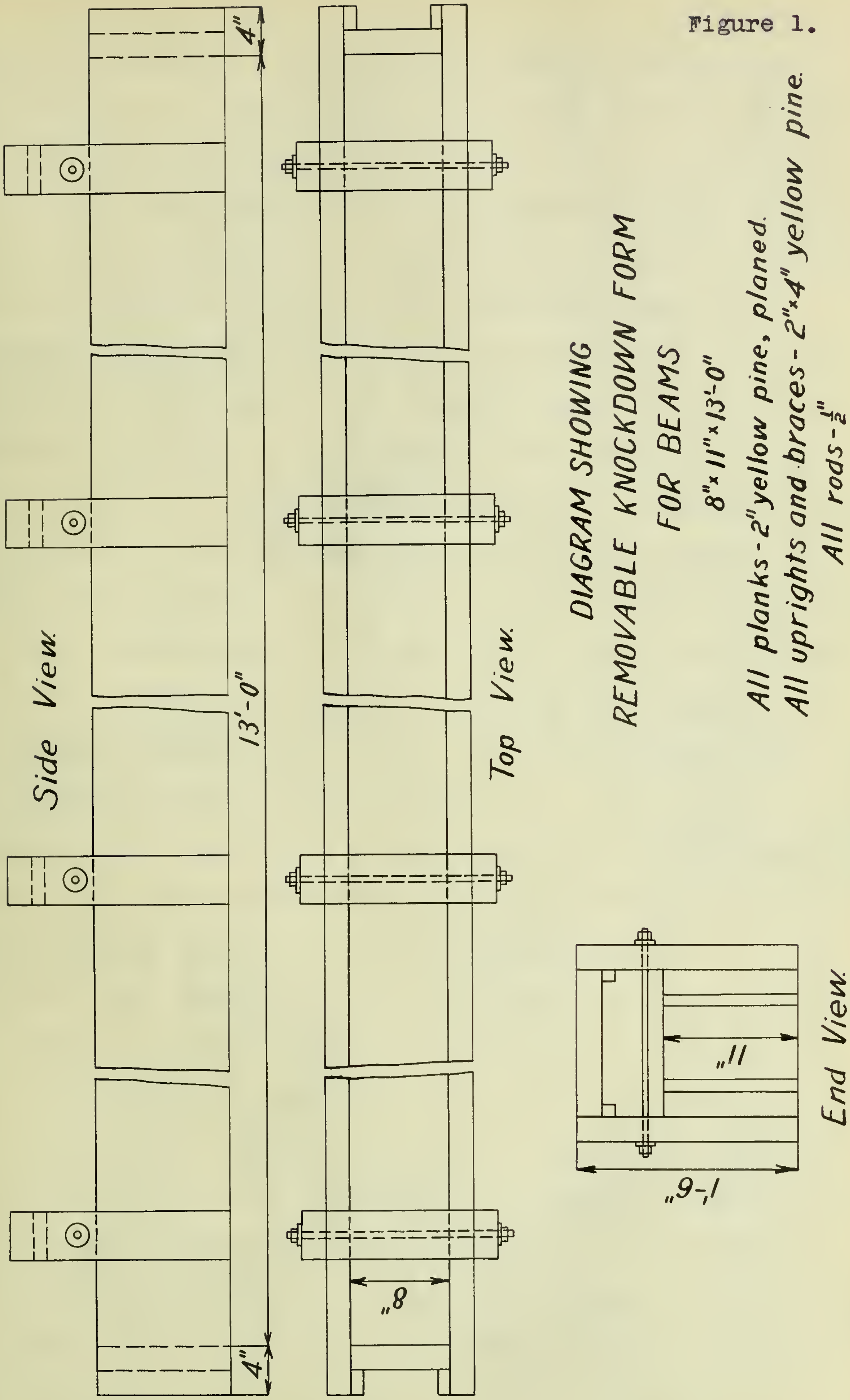
TEST PIECES.

PART II.TEST PIECES.

Test Beams;-The size of the test beams used was 8 in.x 11 in. x 13 ft. 0 in. with a span of 12 ft. 0 in.The center of the steel reinforcement was 10 in. below the top fiber.The percentage of reinforcement is the ratio of the area of the metal to the area of the concrete above the center of the metal.In the series of beams tested the percent of reinforcement was constant being 1 %.The reinforcement consisted of four 1/2 in. mild steel round bars,12 ft. 6 in. long,placed 10 in. below the top, and evenly spaced across the breadth of the beam.The space between the side of the beam and the nearest bar was 1 in. and that between any two consecutive bars was 2 in. The average weight of one of the 28 beams was 1200. lb.,the concrete weighing about 150. lb. per cu. ft.

Making of the Beams;-The beams were made directly upon the concrete floor of the laboratory,a strip of building paper being first spread under the forms.The details of the forms are shown in Fig. 1,page 15.The sides consisted of 2-in. plank,dressed on one surface.The ends were of the same material and were held in place by cleats.The braces were placed every four feet to hold the forms together and to prevent the bulging of the beams during the tamping of the concrete.The forms were very satisfactory except that they allowed some of the beams to warp slightly.The concrete was mixed by hand with shovels,a man experienced in concrete assisting in the work.All materials were mixed by loose volume,however they were all checked by weight. The cement and sand were thoroughly mixed together,water was added,and the mixture was turned until it had uniform con-

Figure 1.


Side View.
Top View.
End View.
4"
13'-0"
4"
8"
11"
1'-6"
DIAGRAM SHOWING
REMOVABLE KNOCKDOWN FORM
FOR BEAMS
8"x11"x13'-0"
All planks - 2" yellow pine, planed.
All uprights and braces - 2"x4" yellow pine.
All rods - 1/2"

sistency. A moderately wet concrete was used, and usually just enough concrete was mixed at one time for one beam and the auxiliary test specimens. A layer of concrete about 1 in. thick was placed in the form and the horizontal reinforcing bars then put in place. The concrete for the remainder of the beam was then deposited in layers of three to four inches, each layer being thoroughly tamped; however no tamping was done in the horizontal plane of the reinforcement lest it should cause a plane of rupture. After each layer had been tamped, a flat spade was forced between the face of the form and the concrete to produce a better surface, and the layer was then retamped. The upper surface was finished with a thin layer of mortar to give a better appearance to the test specimens. The forms were left in place seven days, except for the seven day beams, in which case they remained in place for only six days. The mixtures for the different series of beams varied as shown by Table 30, page 17.

Storage;-The temperature of the laboratory in which the beams were made and stored ranged from about 40 to 70 degrees Fahrenheit. Nothing was done to protect the beams except to wet them down with a hose twice a day until they were tested. However they were neither moved nor disturbed in any way until the time for removal to the testing laboratory. The age of these specimens varied from 4 to 60 days, the exact age at which each beam was tested being given in the tables under the head of original data.

Handling of Beams;-The beams were taken from the laboratory in which they were made to the testing laboratory in a large dray wagon. After reaching the testing laboratory they were placed on the table of the machine by means of a traveling crane.

Table 30.

Data on Beams.

Reinforcement: 1%.

Series.	Number.	Mixture.	Age.
311.	7.	1-2-4.	7.
312.	6.	1-2-4.	14.
313.	2.	1-2-4.	28.
314.	4.	1-2-4.	60.
315.	1.	1-2-4.	4.
316.	2.	1-1-2.	7.
317.	2.	1-1-2.	14.
318.	2.	1-4-8.	7.
319.	2.	1-4-8.	14.
Total.	28.		

Size:-8 in.x11 in.x13 ft.0 in.

PART III.

DETAILS OF TESTS.

PART III. DETAILS OF TESTS.

There were generally three persons engaged in making the tests,although two could manage a test satisfactorily. One ran the machine,keeping the scale arm of the machine balanced and stopping the machine whenever the desired increment of load was reached. For the 4 day beams this increment was 250. lb: for the 7 day beams it was 500. lb: for the 14 day beams it was 500. lb: and for the 24 and 60 day beams it was 1000. lb. Readings were taken at each regular interval of the loading and at any other points it seemed advisable. Such points were found in the dropping of the scale arm,showing a failure in the beam. The observers noted down the readings of the dials and the deflections at the center and it was from these original readings that the computed data were obtained. The pointers on the dials of the extensometers were always placed at 0 before starting the test so that no corrections of the readings were necessary.

When the traveling crane,carrying the beam,had been placed in position at one end of the machine,one end of the beam was lowered onto a dolly and run onto the machine:as soon as the beam was entirely over the table of the machine,the other end was lowered onto a block resting on the table. The beam was then lifted by means of stirrups,suspended from a stationary track over the machine,and operated by chains and pulleys. After being centered,the beam was lowered onto the pedestals,as shown in Fig. 2,page 20. Plates were placed at the third points and between the pedestals and the beam,being set in plaster of paris, in order to distribute the pressure uniformly and to give an even bearing. The extensometers were put in position as shown in

Figure 2.

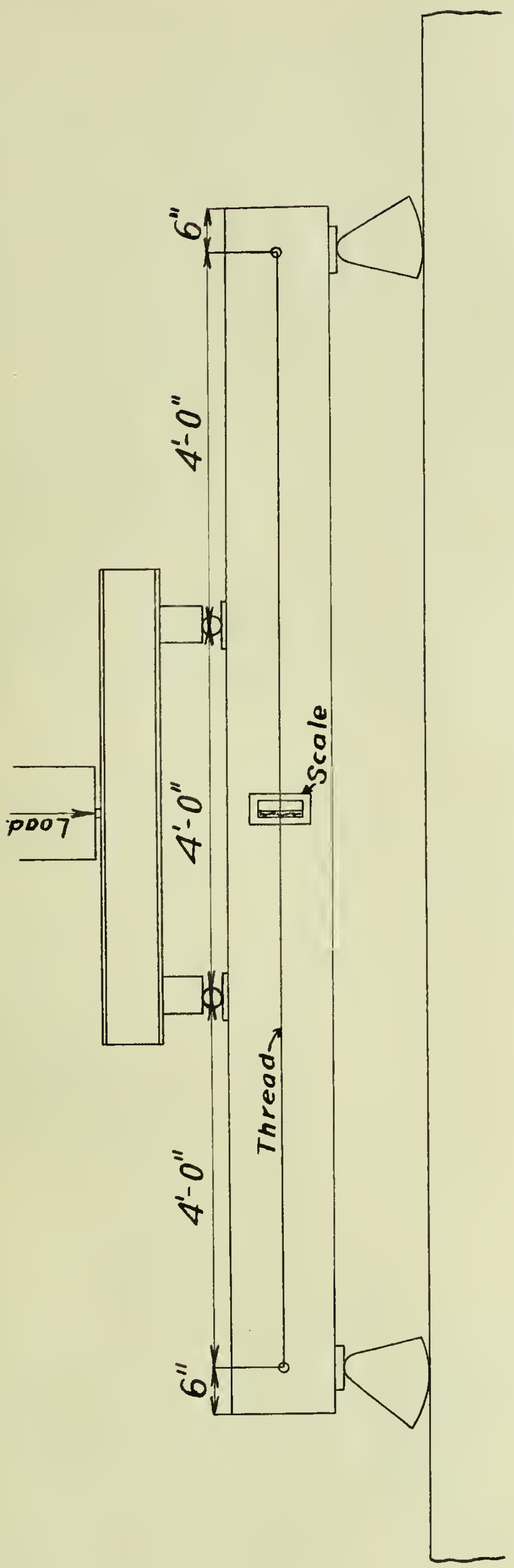
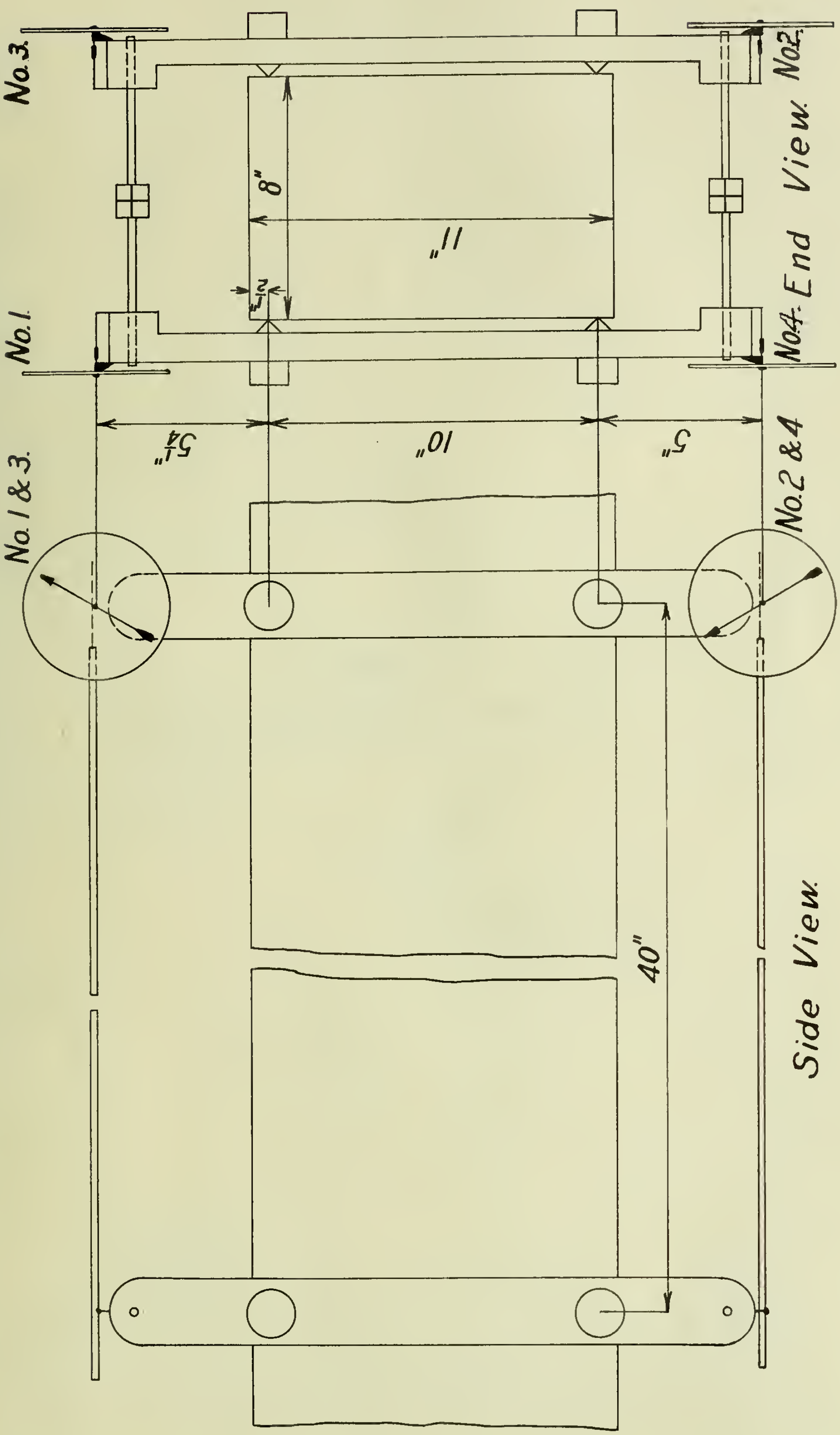


DIAGRAM SHOWING
APPARATUS FOR DEFLECTIONS
AND
METHOD OF APPLYING LOADS

Fig. 3,page 22 ,each yoke being 4 in. inside the third points of the beam. In order to apply the load at the third points an I beam was used as shown in Fig. 2,page 20 . This rested upon a block and roller,which in turn rested upon a steel plate, imbedded in plaster of paris,in order to give a free and equal distribution of the load. Strings,fastened to blocks attached to the lateral surfaces of the beam by plaster of paris,just above the points of support,were stretched across the center of the beam. A scale and mirror were then fastened to the middle of the beam,on both lateral surfaces,by plaster of paris,and the beam was then ready for the load to be applied. The arrangement of the beam in the machine is shown in Fig. 2,page 20 .

Figure 3.



ARRANGEMENT OF EXTENSOMETERS

PART IV.

EXPERIMENTAL DATA.

PART IV. EXPERIMENTAL DATA.

The following short description of each beam is given to explain the manner of failure. Table 39, page 44, gives the method of failure for each beam.

Beam 311.1

1-2-4 Concrete; Chicago AA Portland Cement; 7 Day test. First signs of failure appeared on the top surface of the beam at a load of 3370. lb. After taking this load the beam failed rapidly by compression. See Table 1, page 84.

Beam 311.2

1-2-4 Concrete; Chicago AA Portland Cement; 7 Day test. A load of 5380. lb. was applied, which dropped to 5000. lb. before any signs of failure were noticed. Signs of flaking on the top surface at this load indicated that the beam was failing by compression. See Table 2, page 85.

Beam 311.3

1-2-4 Concrete; Chicago AA Portland Cement; 7 Day test. This beam took a load of 5800. lb. before showing signs of failure. At this load a crack was noticed 3 in. north of the south extensometer on the left surface of the beam. The beam kept taking load up to 6000. lb. and failed then by compression. See Table 3, page 86.

Beam 311.5

1-2-4 Concrete; Universal Portland Cement; 7 Day test. The first signs of failure appeared at a load of 2860. lb. Before failure the beam had taken a load of 2950. lb. but this had dropped to 2860. lb. when crushing failure was noticed on the top surface, 6 in. north of the center. The high speed was then

applied and the beam failed rapidly by compression. See Table 4, page 87.

Beam 311.6

1-2-4 Concrete; Universal Portland Cement; 7 Day test. No signs of failure appeared until the beam broke very suddenly under a load of 6550. lb. The beam failed by diagonal tension. See Table 5, page 88.

Beam 311.7

1-2-4 Concrete; Universal Portland Cement; 7 Day test. At a load of 5150. lb. signs of compression appeared on the top surface, south of the center of the beam. The beam failed by compression. See Table 6, page 89.

Beam 311.8

1-2-4 Concrete; Universal Portland Cement; 7 Day test. Signs of compression appeared in the middle third of the top surface at a load of 5300. lb. The beam failed by compression. See Table 7, page 90.

Beam 312.1

1-2-4 Concrete; Chicago AA Portland Cement; 14 Day test. The beam was very smooth and dry. At 8750. lb. a crack appeared 2-1/2 in. inside of the north load on both side surfaces. Signs of crushing also appeared above this crack on the top surface. The beam failed rapidly by compression. See Table 8, page 91.

Beam 312.2

1-2-4 Concrete; Chicago AA Portland Cement; 14 Day test. Compression cracks appeared at the center of the top surface at a load of 9250. lb. The beam failed by compression. See Table 9, page 92.

Beam 312.3

1-2-4 Concrete;Chicago AA Portland Cement;14 Day test. At a load of 8000.lb a crack appeared on the bottom of the beam at a point 1 in. south of the north load point.This crack widened as further load was applied and the beam failed by tension.See Table 10,page 93.

Beam 312.5

1-2-4 Concrete;Universal Portland Cement;14 Day test. At a load of 6700.lb. a small crack appeared on the right surface near the bottom,at a point 10 in. north of the south load point.This crack did not increase any,and after taking a load of 8000.lb. the beam failed by compression.See Table 11,page 94.

Beam 312.6

1-2-4 Concrete;Universal Portland Cement;14 Day test. The beam failed by compression at a load of 8000.lb.See Table 12,page 95.

Beam 312.7

1-2-4 Concrete;Universal Portland Cement;14 Day test. The beam failed by diagonal tension at a load of 7700.lb. See Table 13,page 96.

Beam 313.5

1-2-4 Concrete;Universal Portland Cement;24 Day test. Cracks appeared on bottom and both side surfaces of the beam about 10 in. north of the south load point at a load of 9500.lb. The load fell off to 8500.lb. when signs of compression appeared on the top surface.The beam,however failed by tension.See Table 14,page 97.

Beam 313.6

1-2-4 Concrete;Universal Portland Cement;77 Day test. The first sign of failure was a crack across the bottom at a load of 11000.lb. The beam took load up to 11350.lb. and then failed rapidly by tension.See Table 15,page 98.

Beam 314.1

1-2-4 Concrete;Chicago AA Portland Cement;63 Day test. At 10500.lb. fine vertical cracks appeared on both side surfaces of the beam at the center of the middle third.The beam took load up to 11800.lb.and then failed by tension in the steel.See Table 16,page 99.

Beam 314.2

1-2-4 Concrete;Chicago AA Portland Cement;63 Day test. The beam failed by diagonal tension at a load of 10000.lb. See Photograph 1,page 111,and Table 17,page 100.

Beam 314.5

1-2-4 Concrete;Universal Portland Cement;67 Day test. The beam failed by tension at a load of 10850.lb. See Table 18, page 101.

Beam 314.6

1-2-4 Concrete;Universal Portland Cement;63 Day test. The beam failed by tension at a load of 11300.lb. See Table 19, page 102.

Beam 315.5

1-2-4 Concrete;Universal Portland Cement;4 Day test. At 2450.lb the first signs of crushing appeared on the top surface.The beam failed rapidly by compression.See Table 20,page 103.

Beam 316.5

1-1-2 Concrete;Universal Portland Cement;7 Day test.
The beam appeared very dry and hard.The first signs of failure appeared at a load of 9500.lb.,7 in. inside the south load point,on the right hand side.The beam took load up to 10000.lb. Then the load dropped to 9000.lb. when crushing started on the top surface.The beam failed by tension.See Table 21,page 104.

Beam 316.6

1-1-2 Concrete;Universal Portland Cement;7 Day test.
The beam appeared very hard and dry.At a load of 9000.lb. cracks appeared 18 in. south of the north load point on both side surfaces.Then signs of crushing appeared above these cracks on the top surface.The beam failed by tension.See Table 22,page 105.

Beam 317.5

1-1-2 Concrete;Universal Portland Cement;14 Day test.
The beam failed by tension at a load of 11200.lb. See Table 23, page 106.

Beam 317.6

1-1-2 Concrete;Universal Portland Cement;14 Day test.
At a load of 9000.lb. cracks started on both side surfaces at the bottom,9 in. north of the south load point;also at a point 12 in. south of the north load point on both side surfaces.The beam failed by tension.See Table 24,page 107.

Beam 318.5

1-4-8 Concrete;Universal Portland Cement;7 Day test.
After taking a load of 3800.lb. the load dropped to 3500.lb when the first signs of crushing appeared on the top surface. The beam failed by compression.See Table 25,page 108.

Beam 318.6

1-4-8 Concrete;Universal Portland Cement;7 Day test. The beam broke very suddenly at a load of 2300.lb. See Photograph 2,page112 ,and Table 26,page 109.

Beam 319.5

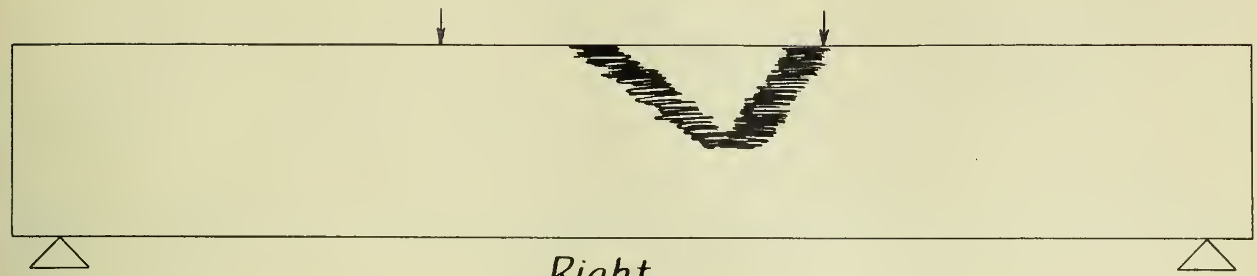
1-4-8 Concrete;Universal Portland Cement;17 Day test. At a load of 9800.lb. a fine crack appeared 7 in. south of the north load on the right side and 8 in. south of the north load on the left side of the beam.The beam failed by tension.See Table 27,page 110.

Beam 319.6

1-4-8 Concrete;Universal Portland Cement;14 Day test. The beam failed by compression at a load of 3250.lb. See Table 28,page 111.

These sketches show the beams after failure.

Beam 311.1



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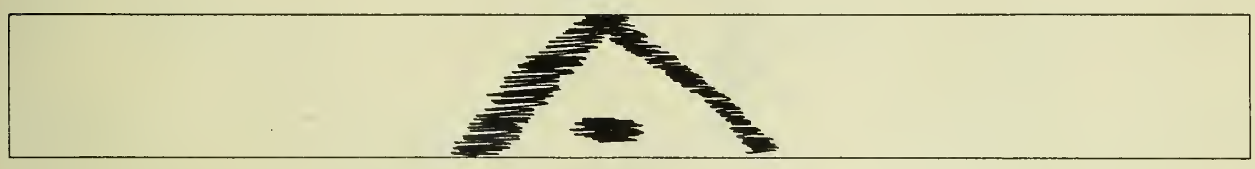

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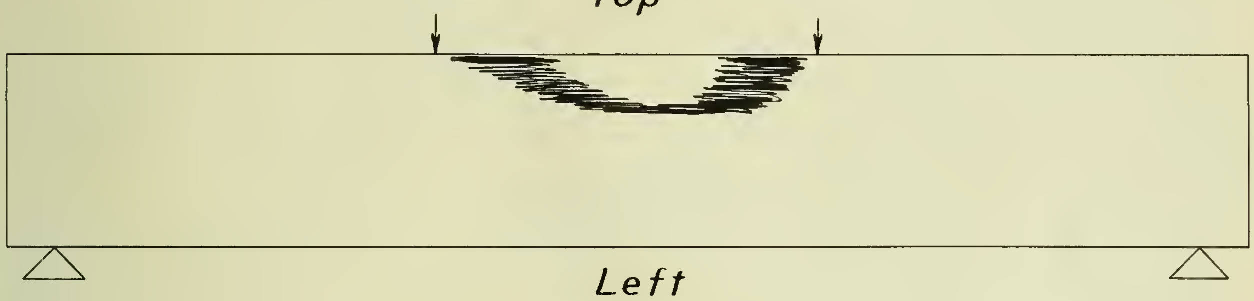

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Beam 311.2

Right

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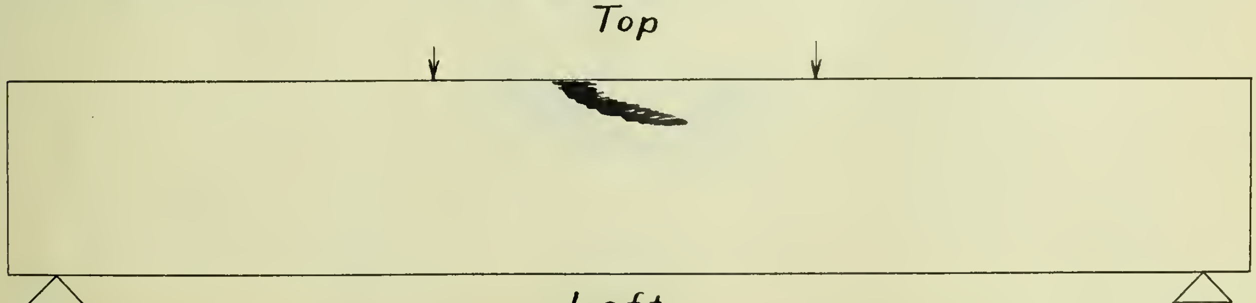

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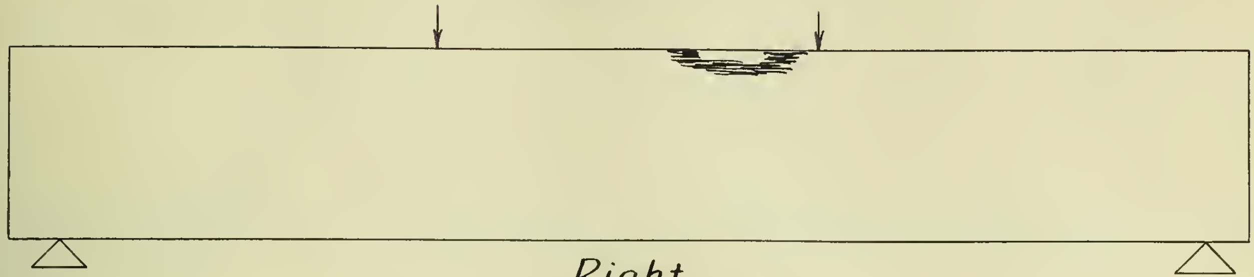
Beam 311.3



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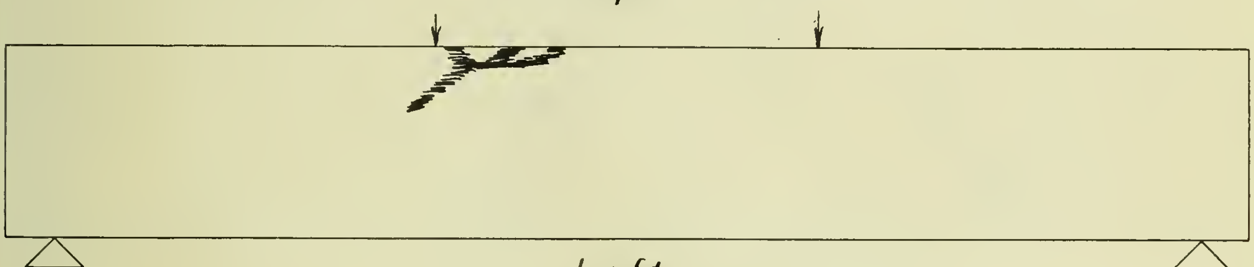

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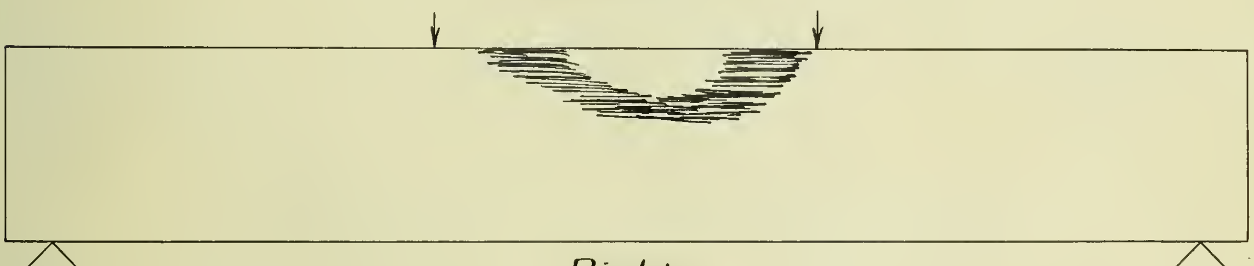
Beam 311.5



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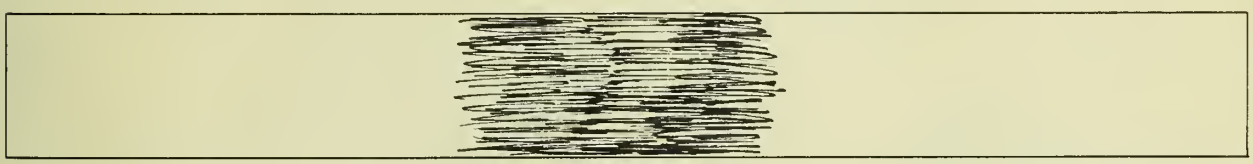

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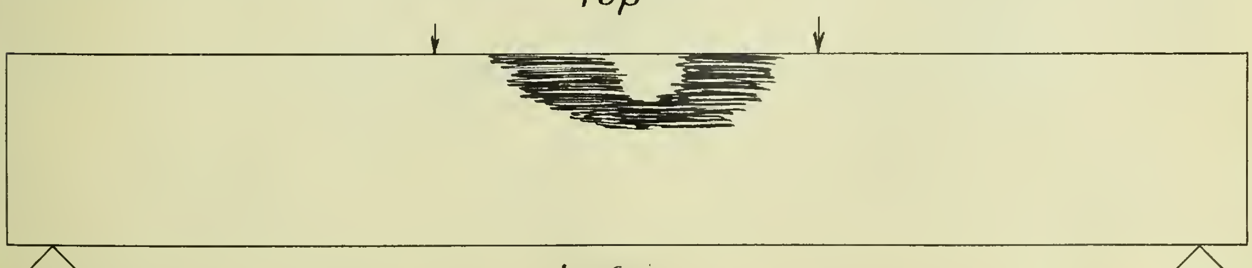

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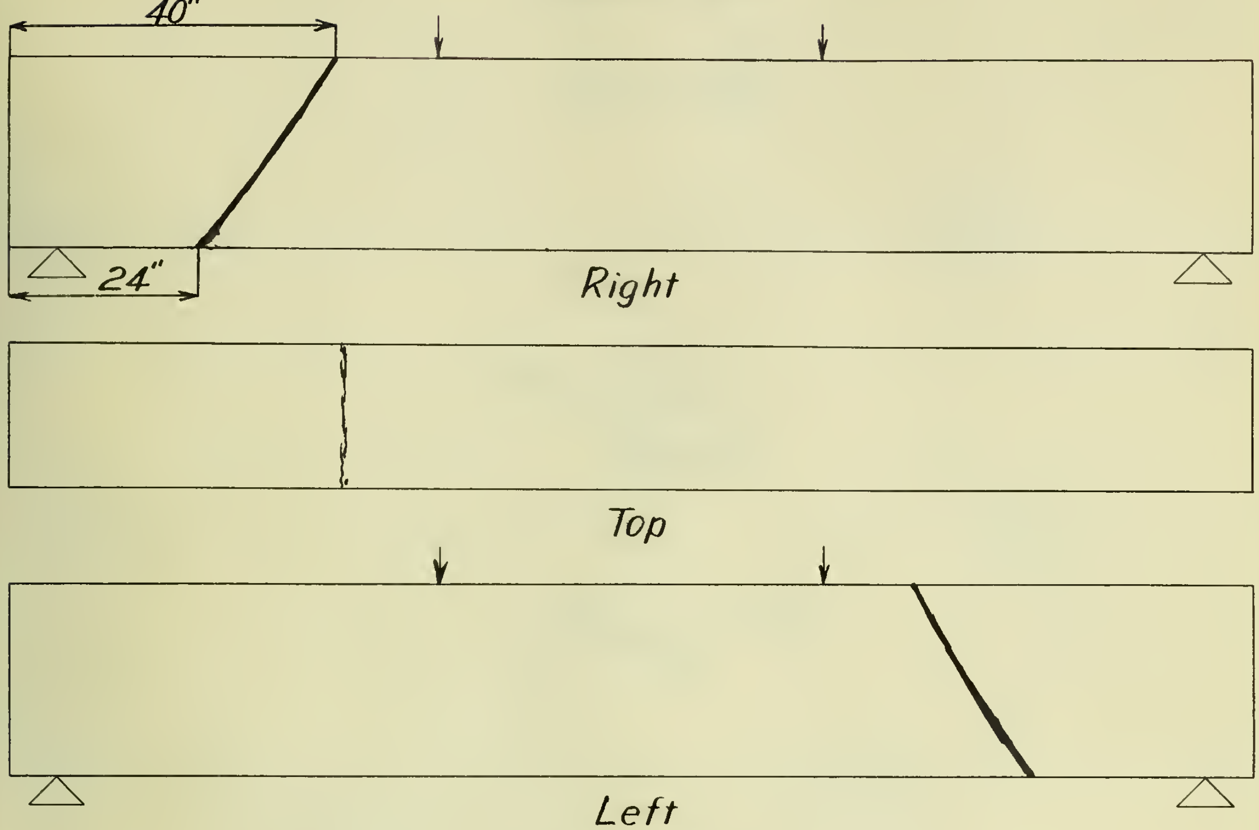
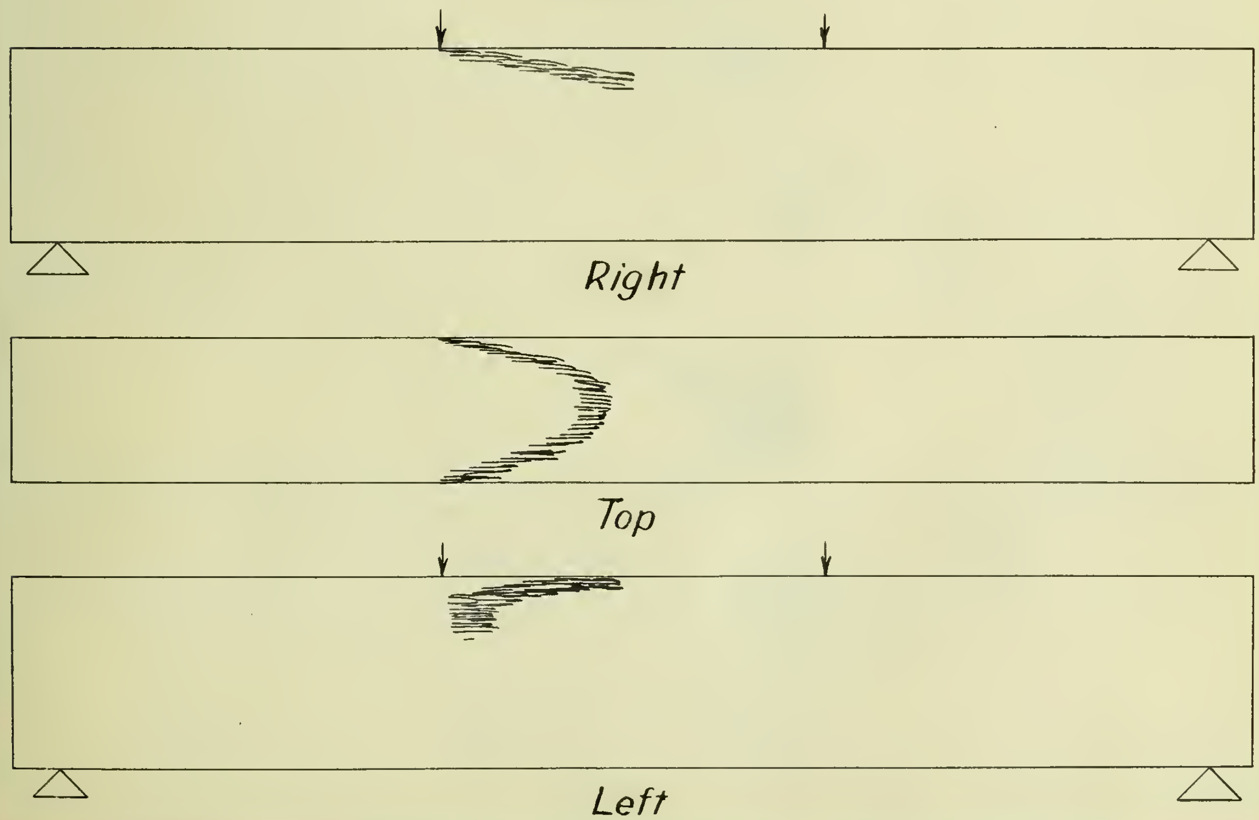
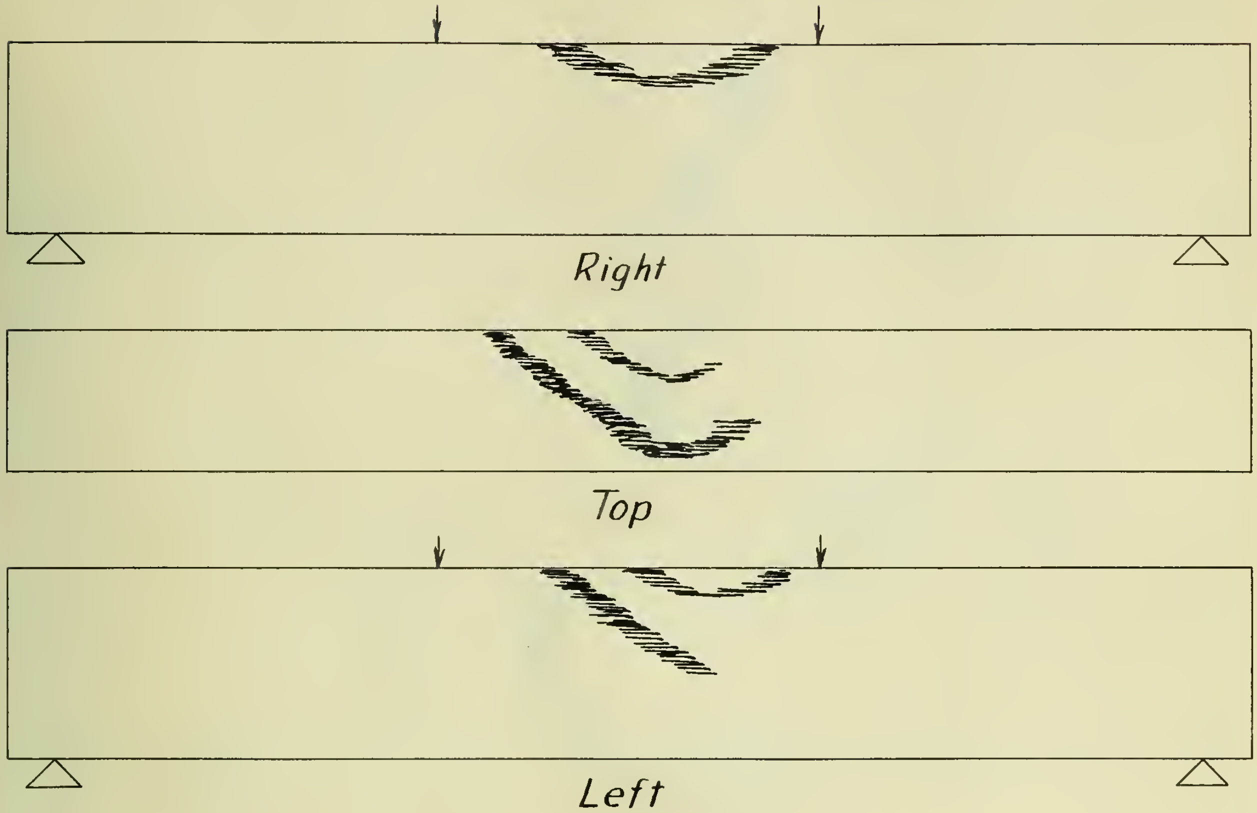
Beam 311.6



Beam 311.7



Beam 311.8



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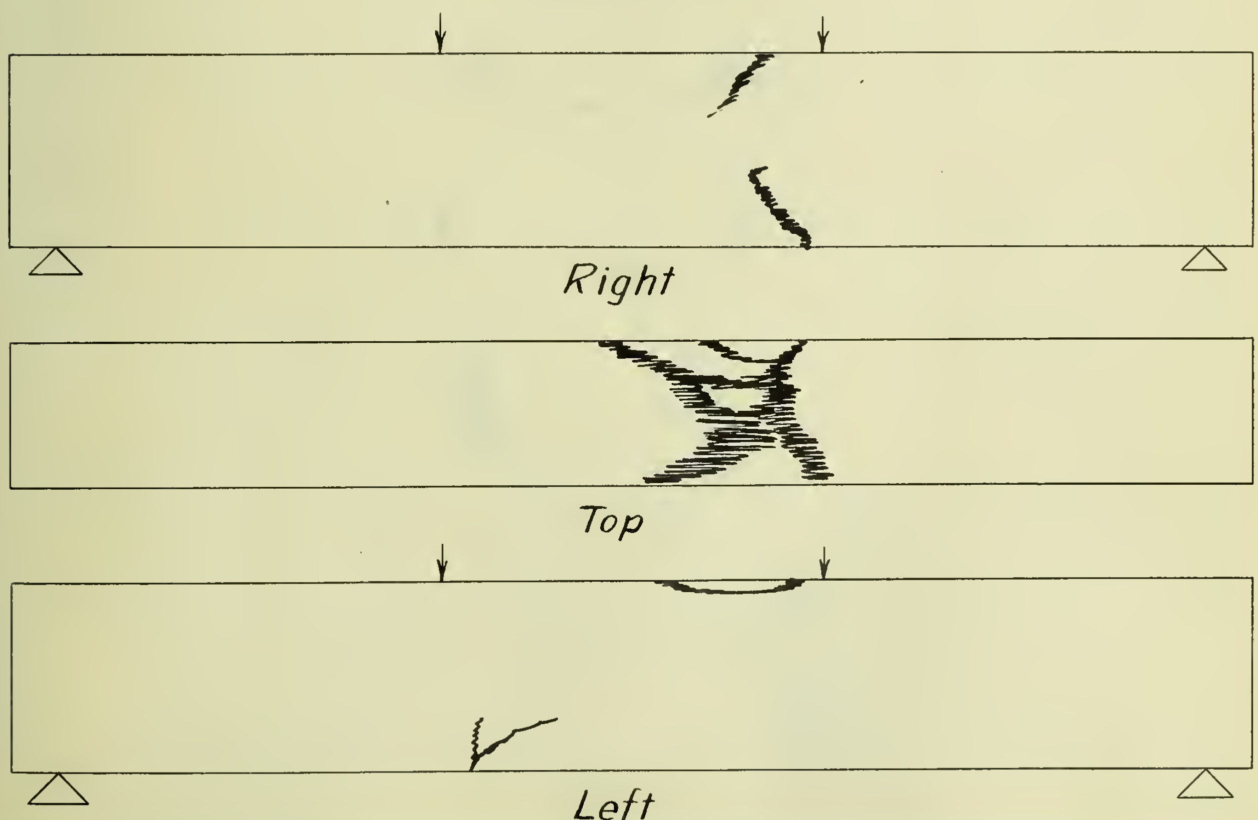
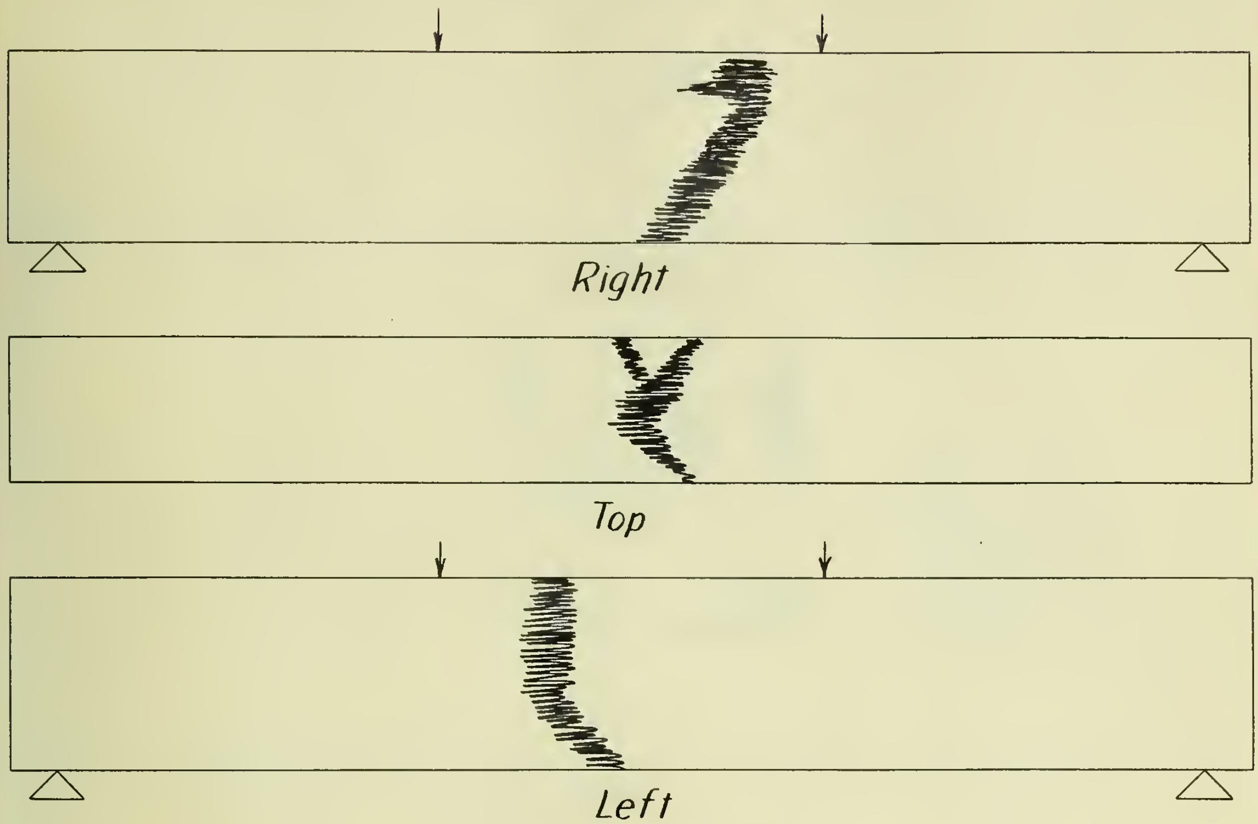
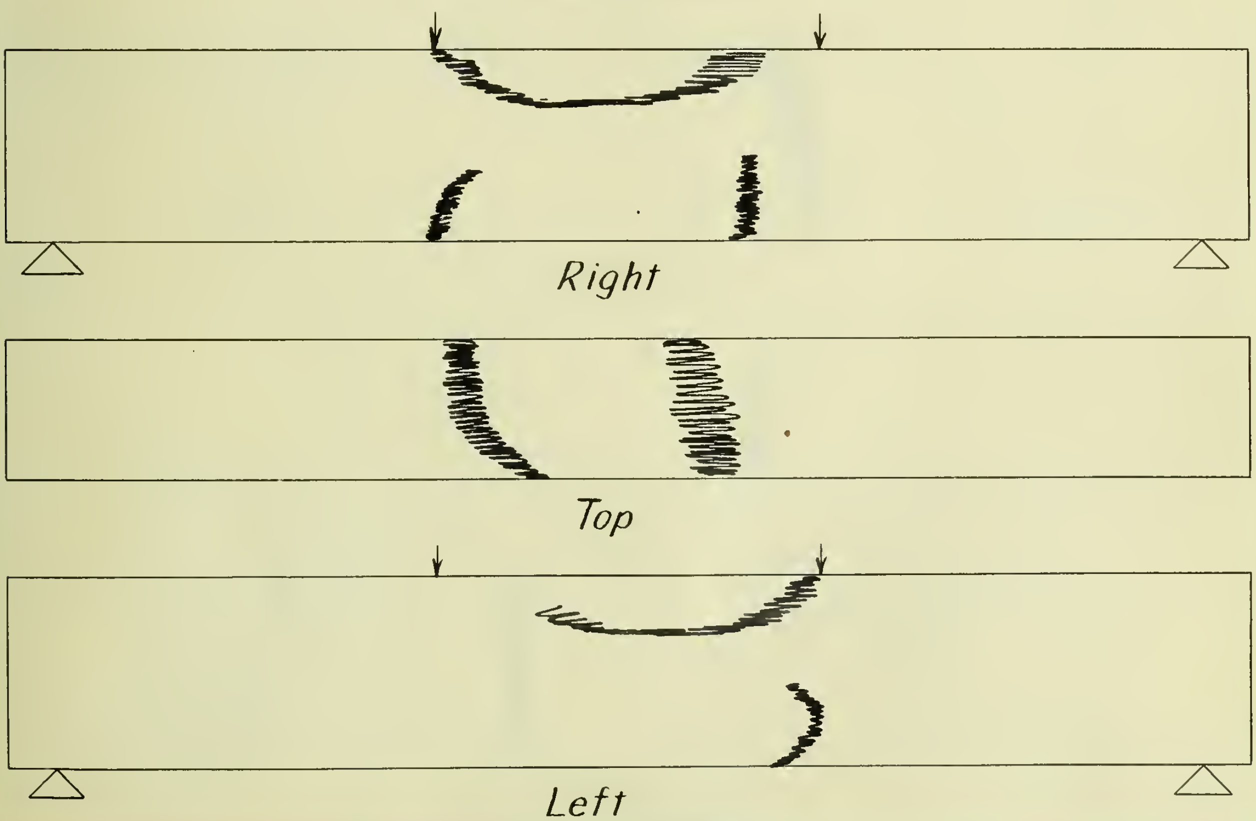


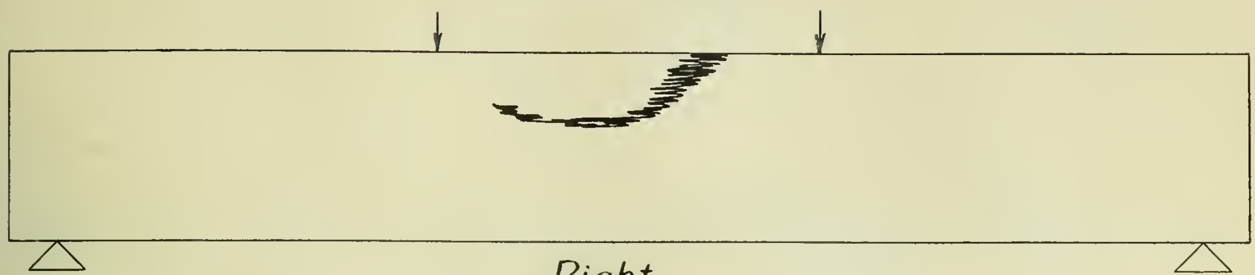
Beam 312.2



Beam 312.3



Beam 312.5



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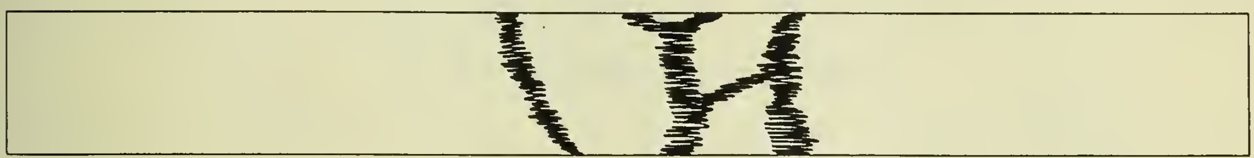

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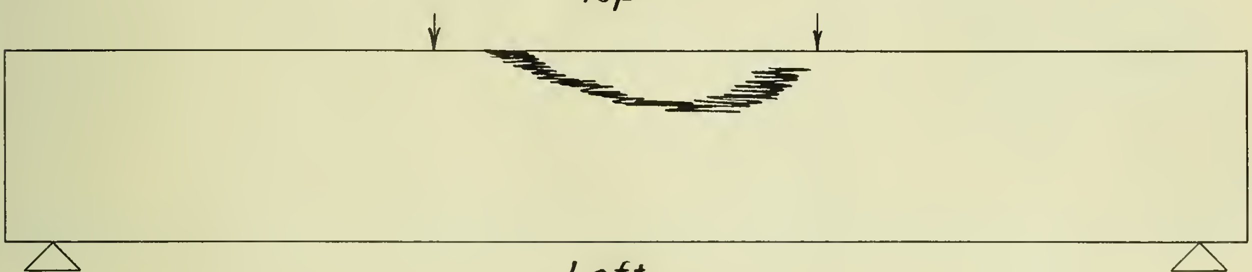

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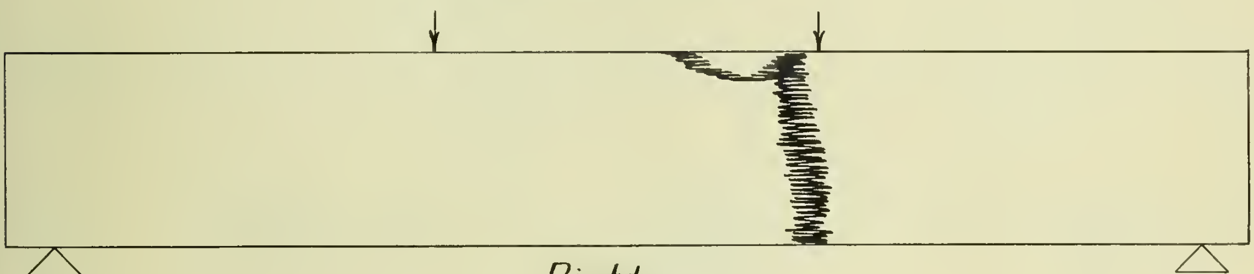
Beam 312.6



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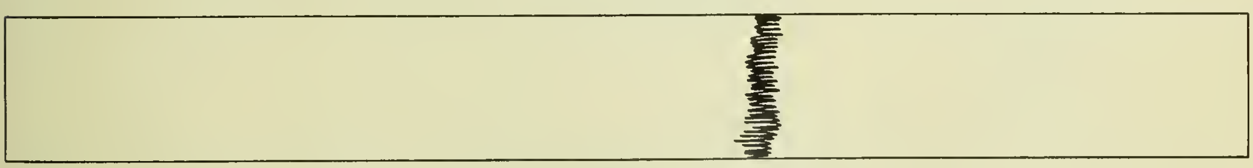

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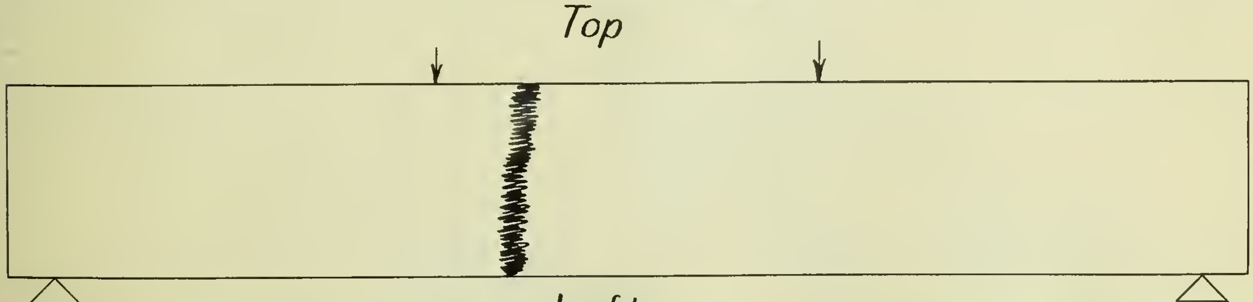

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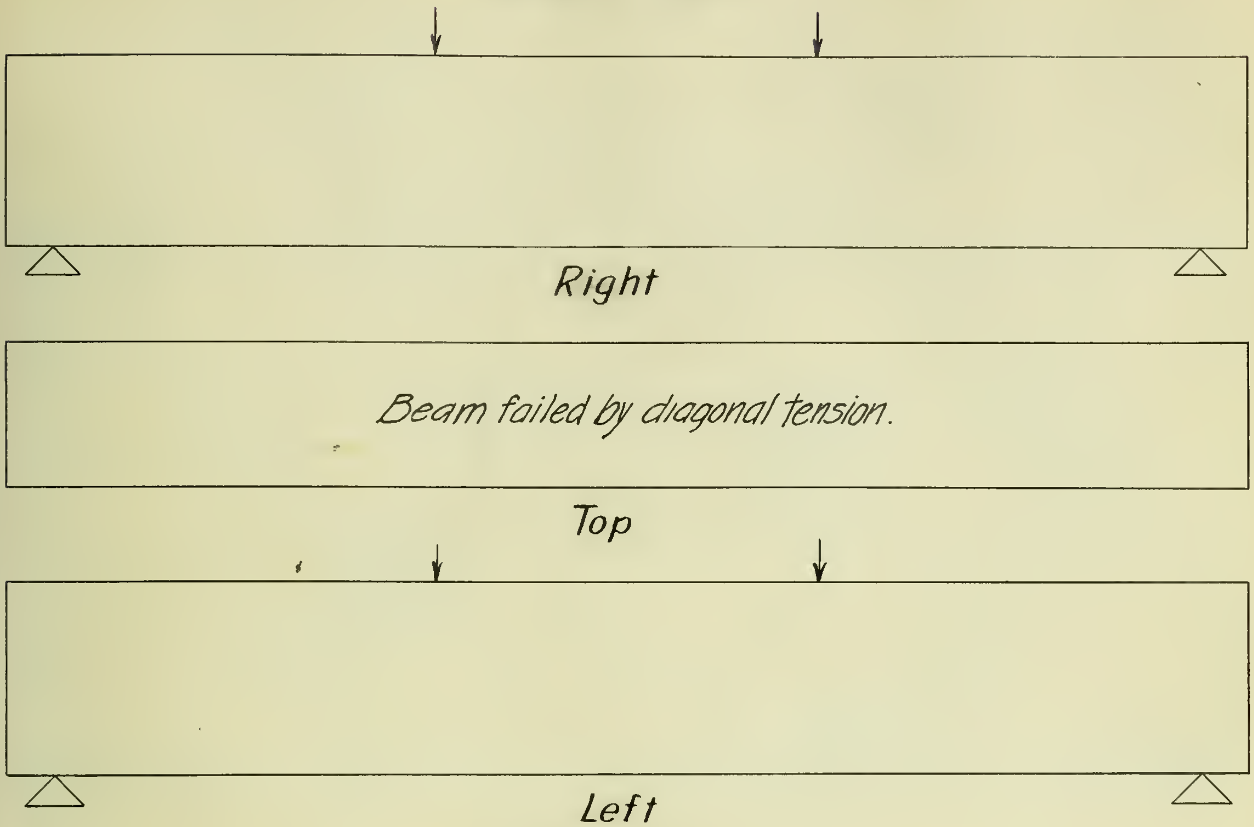

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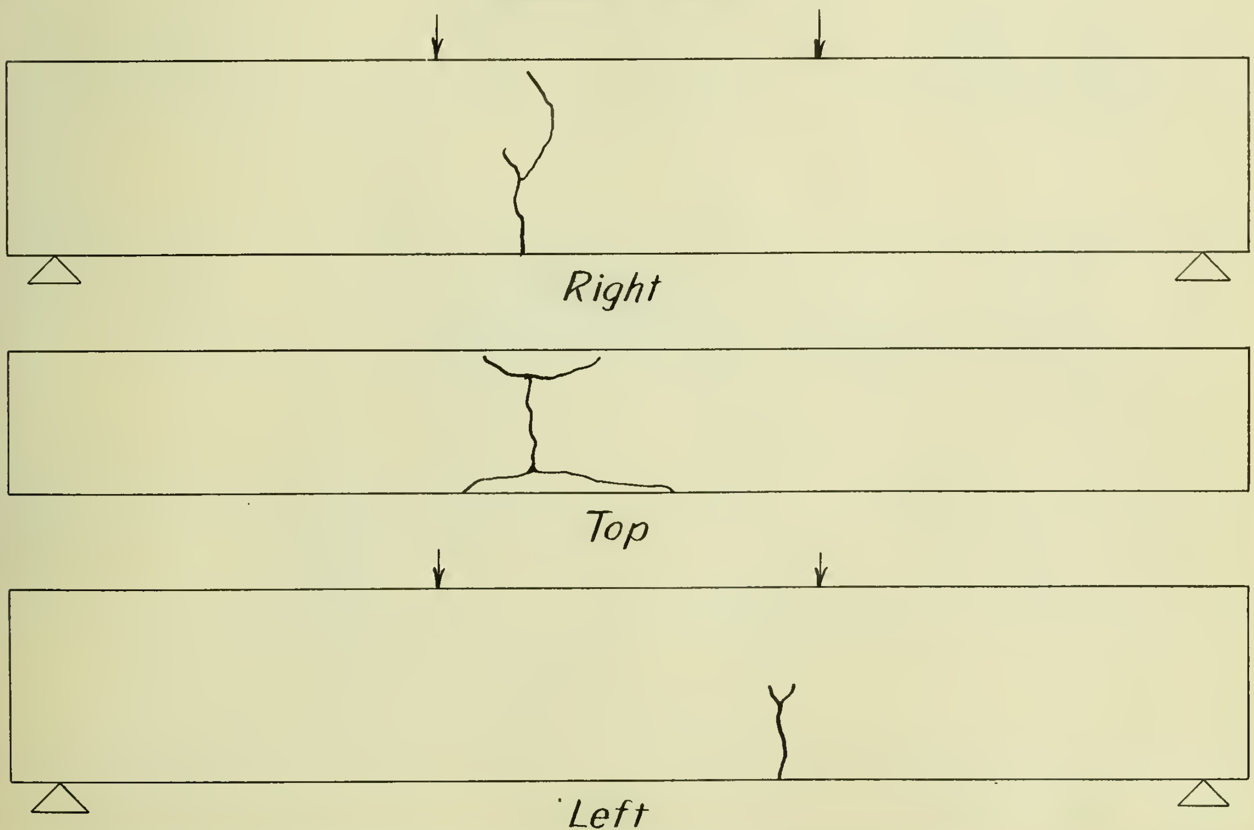

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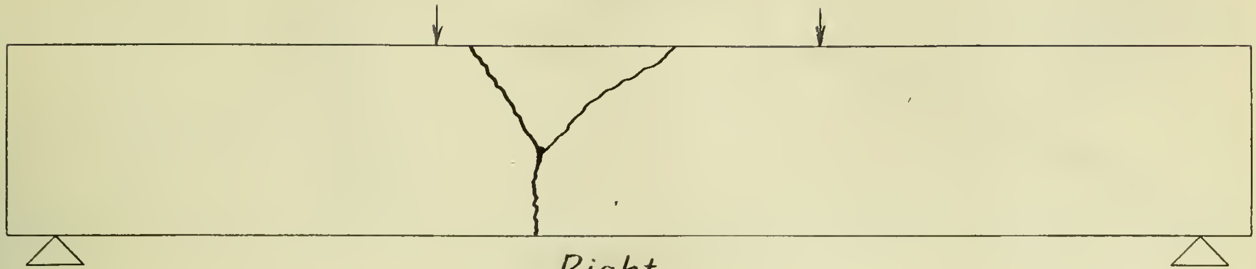

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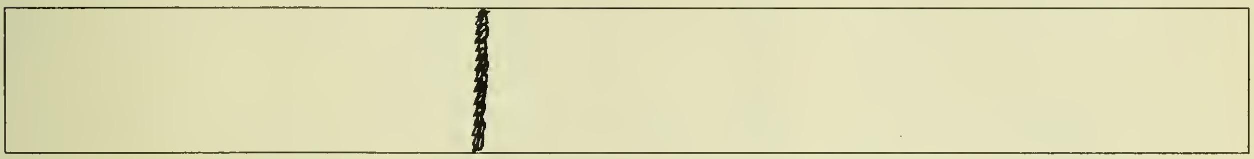

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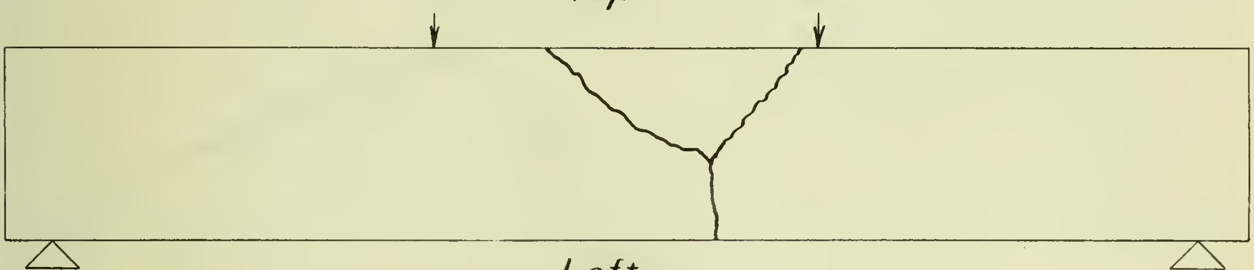

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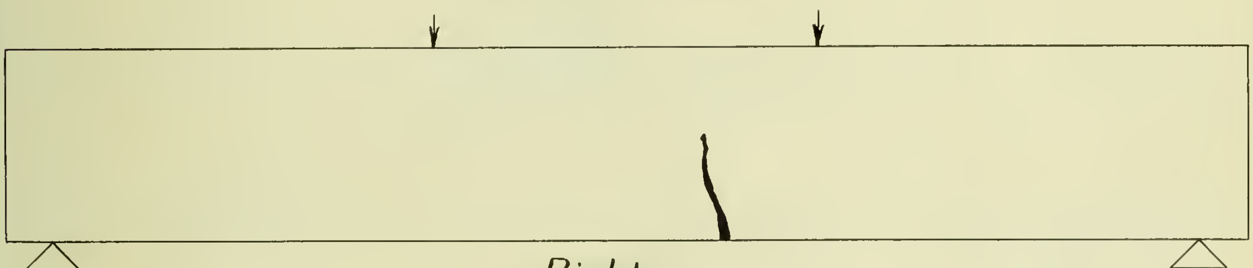
Beam 314.1



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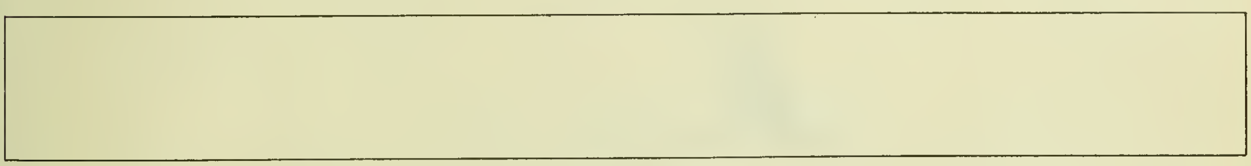

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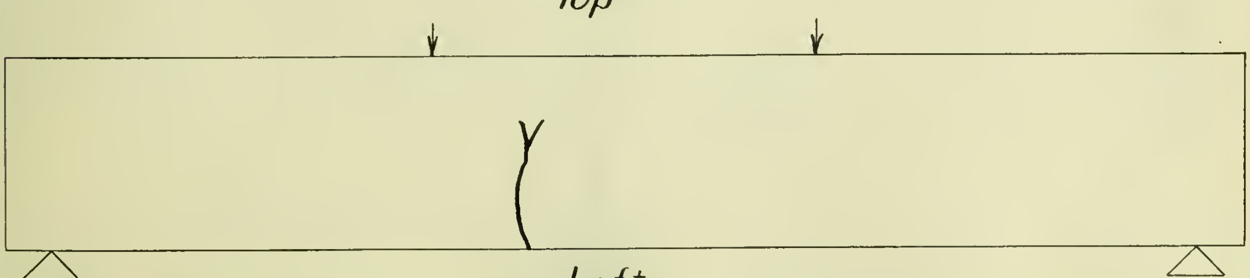

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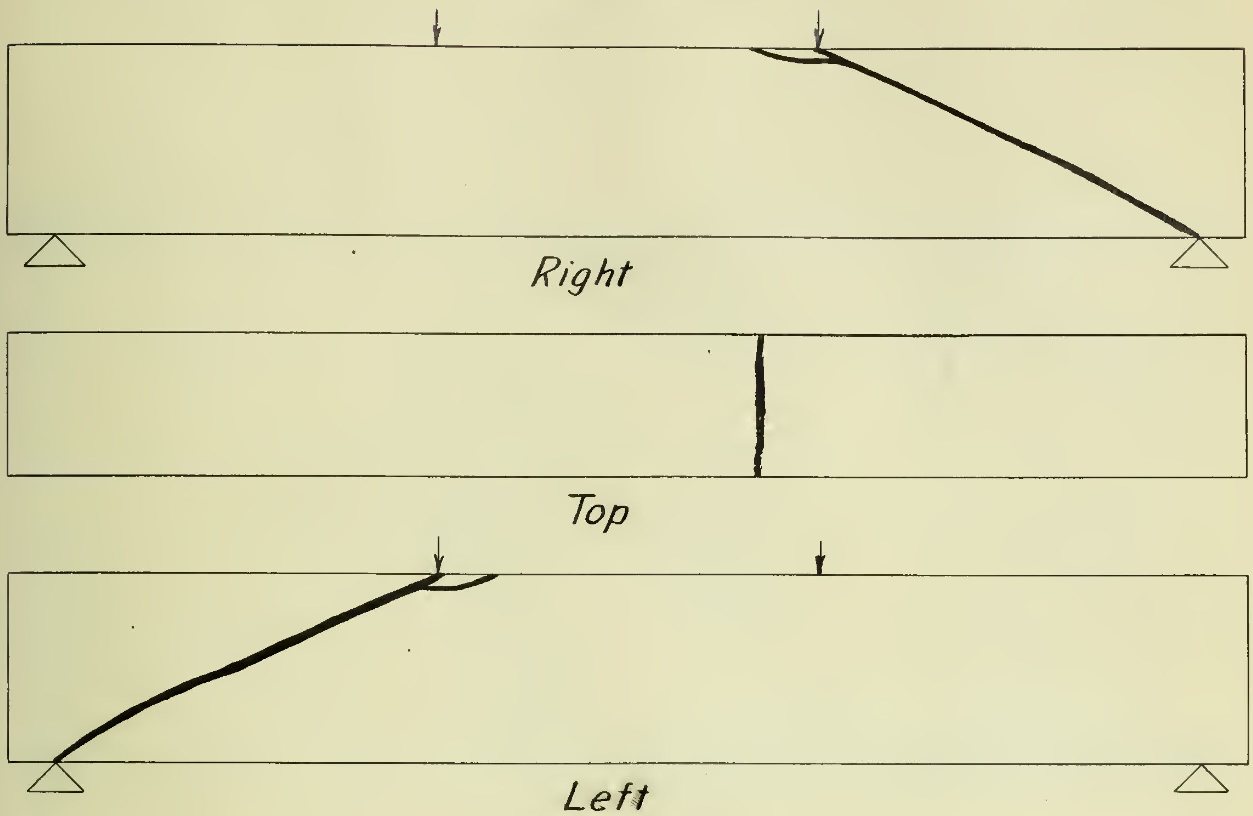
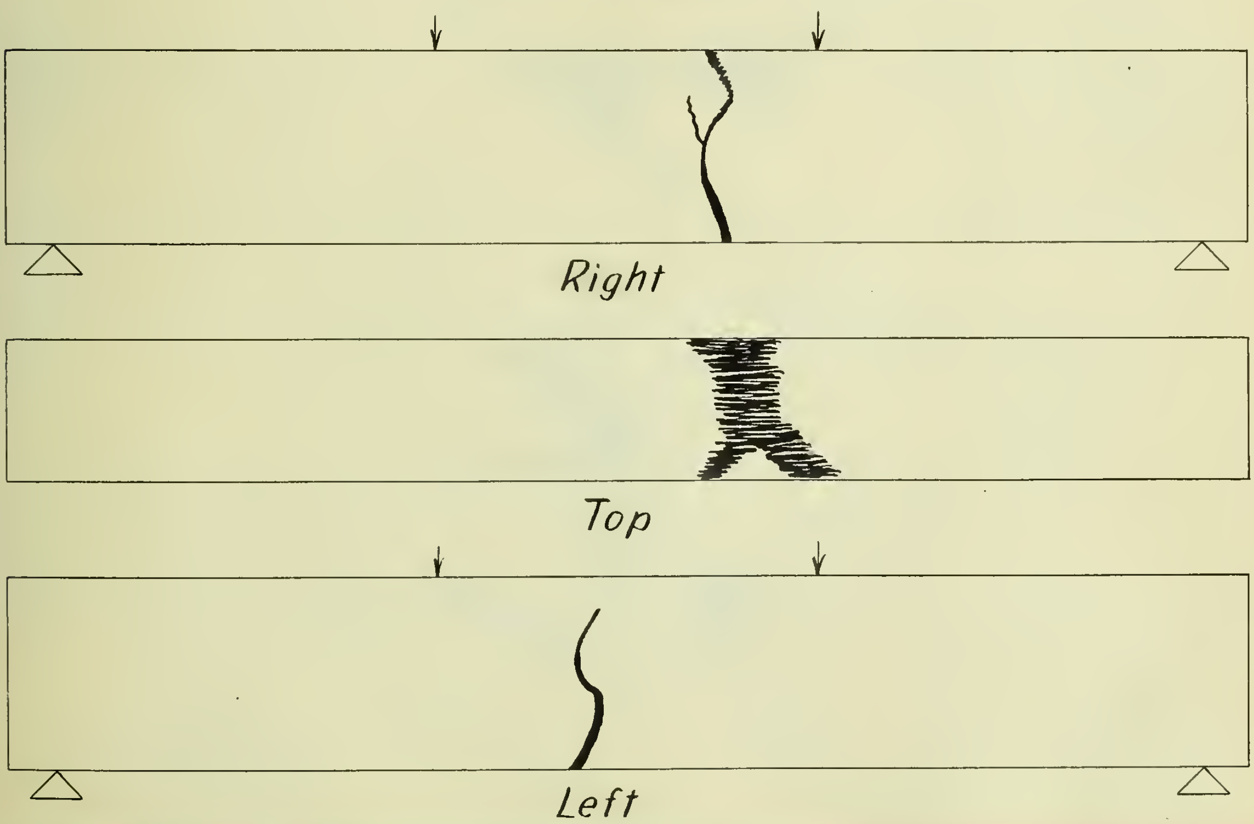
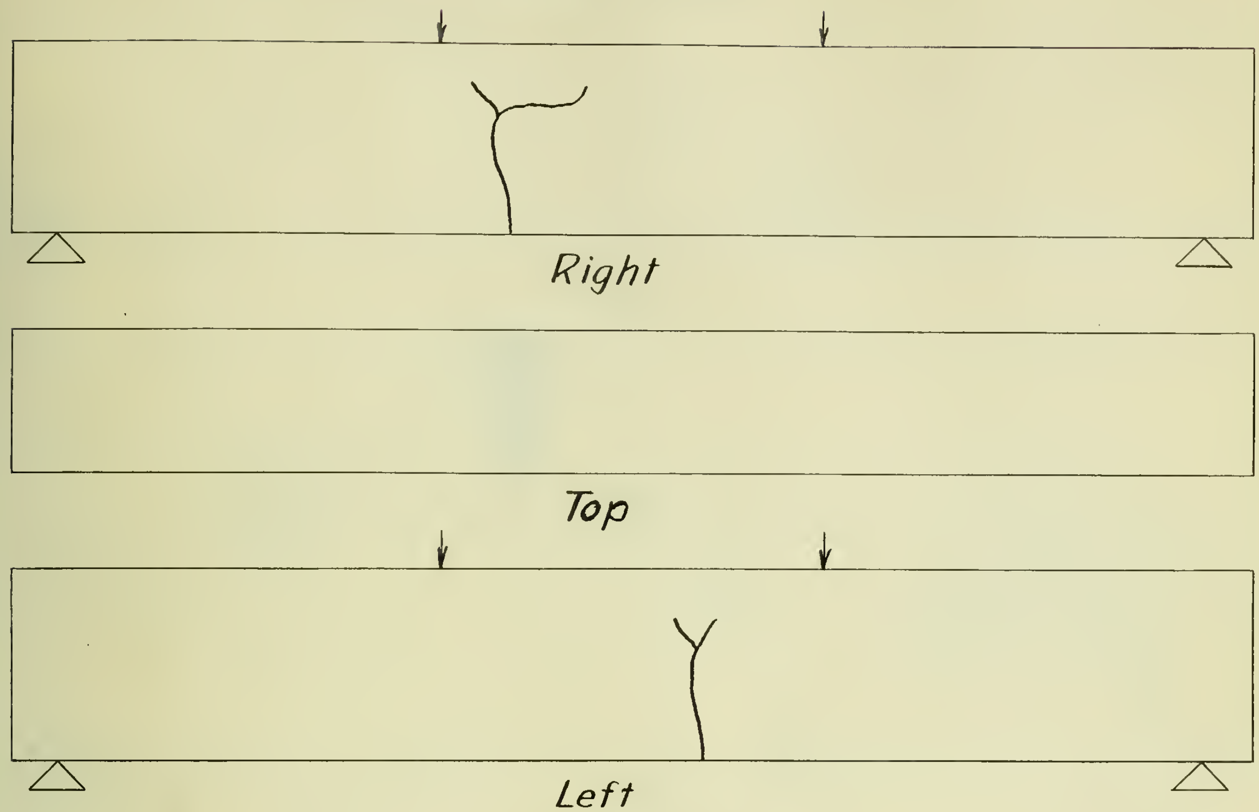
Beam 314.2



Beam 314.5



Beam 314.6



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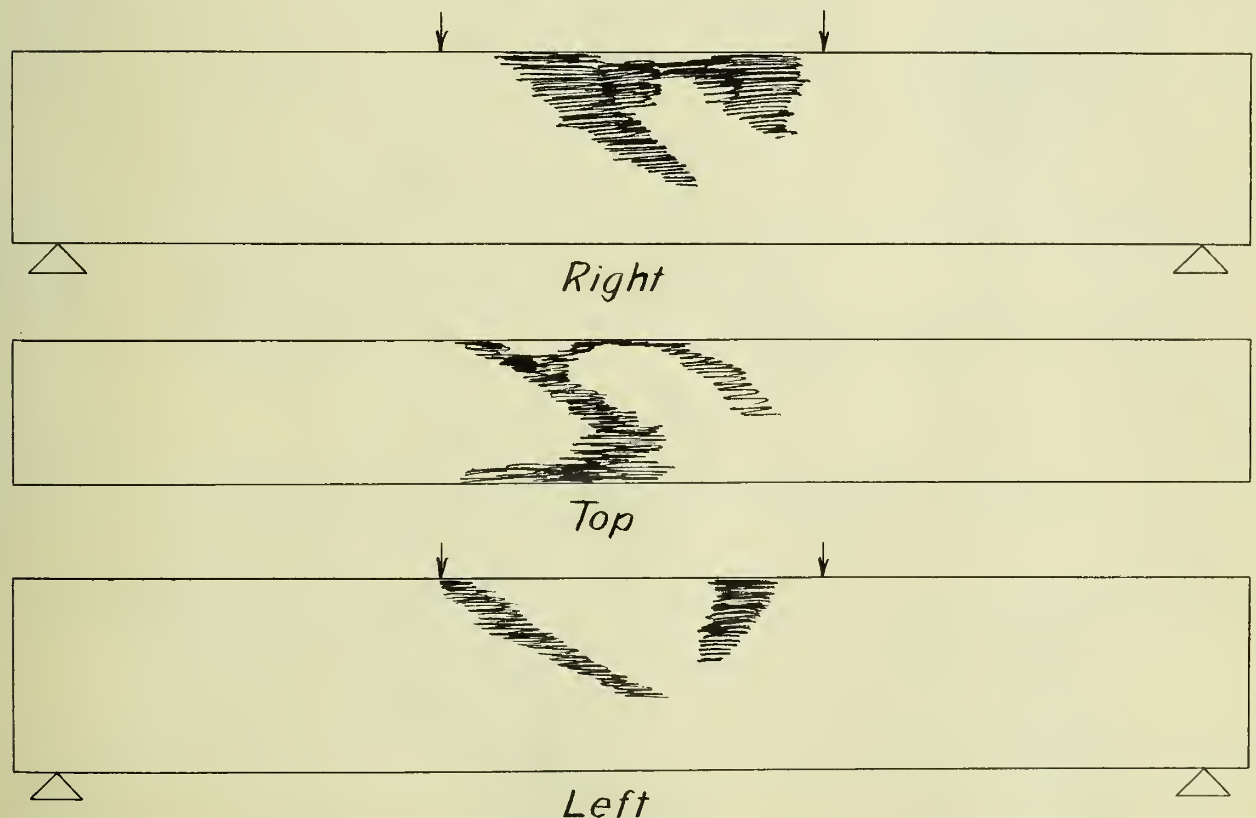

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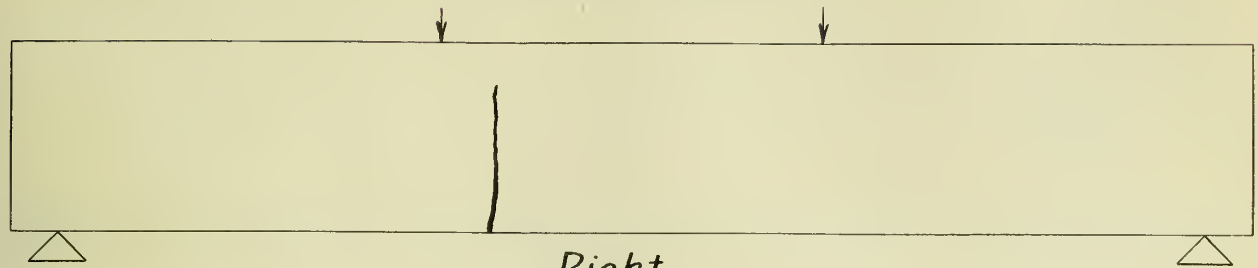

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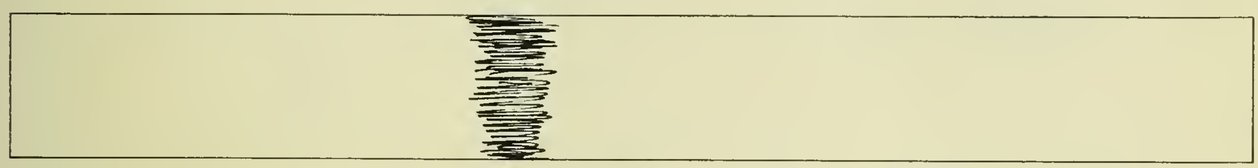

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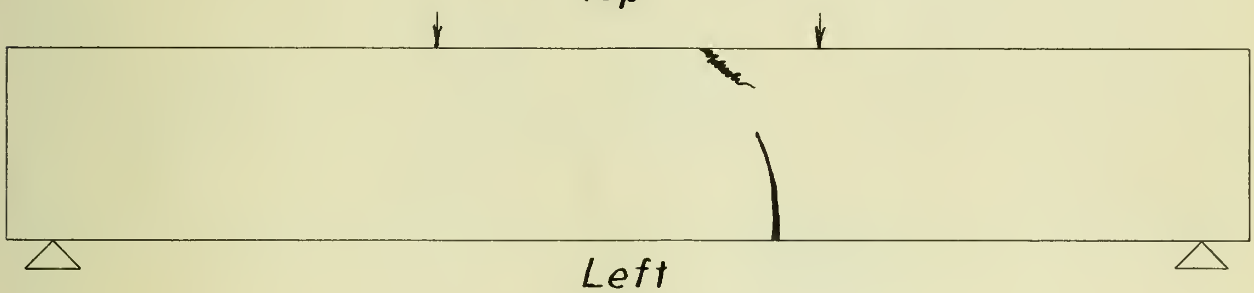

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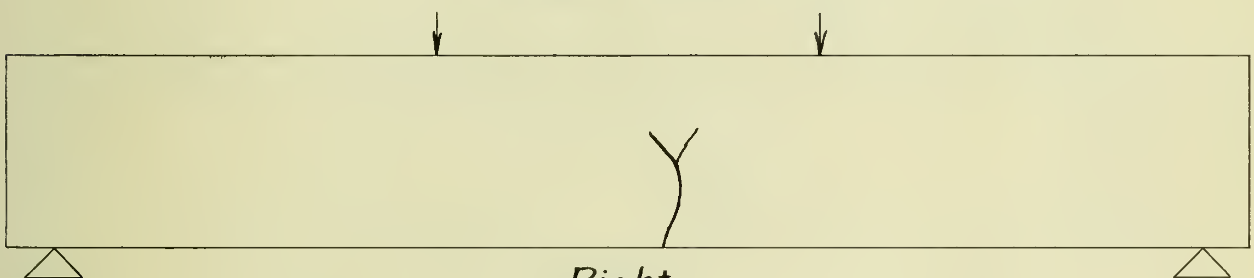

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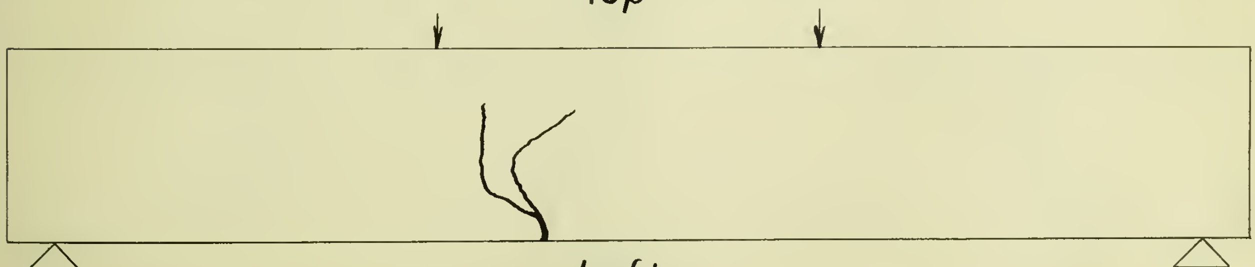

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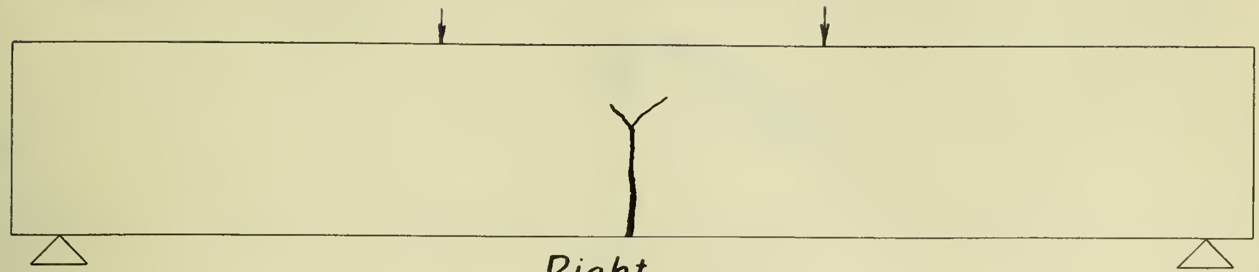

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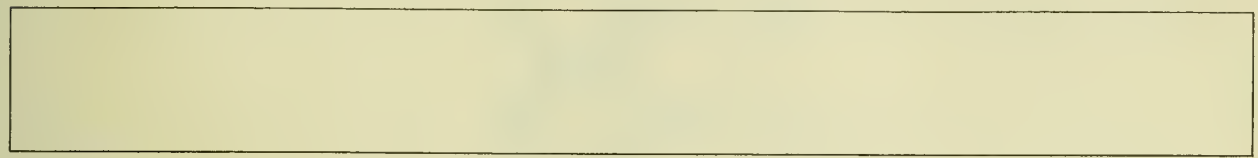

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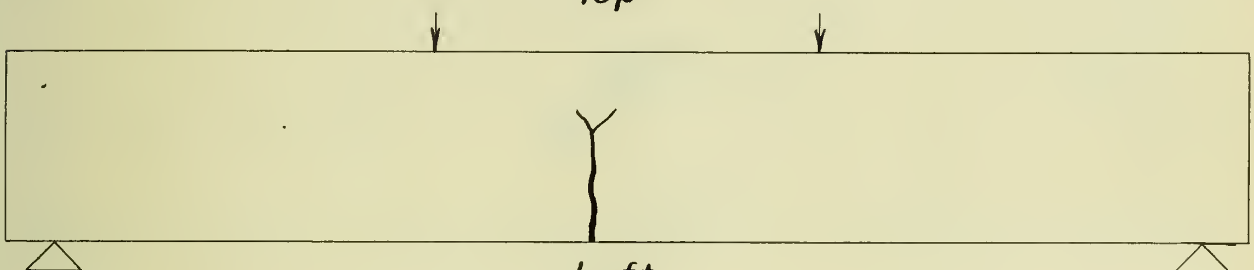

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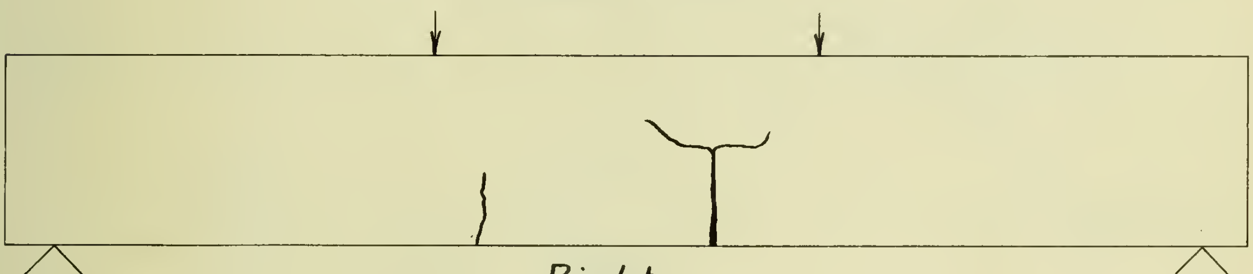

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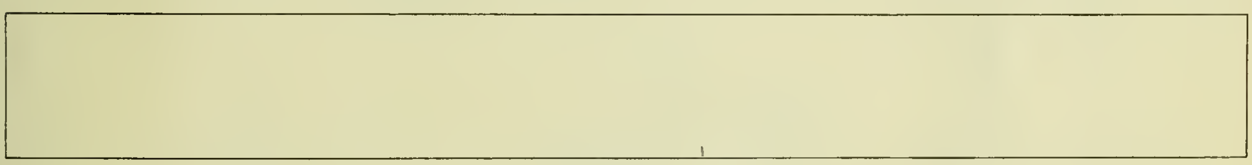

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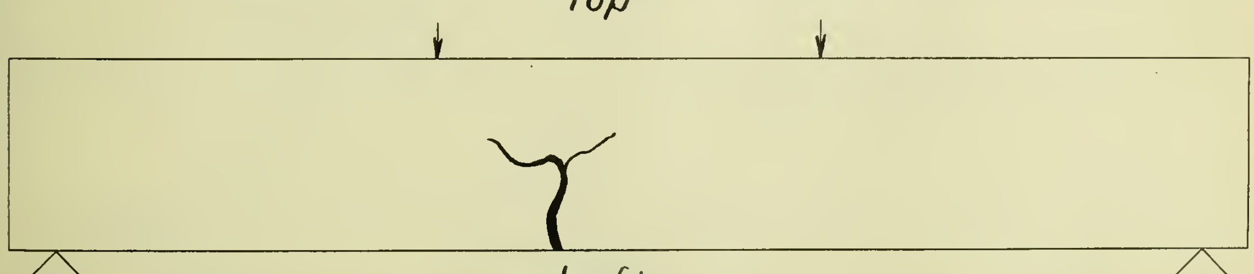

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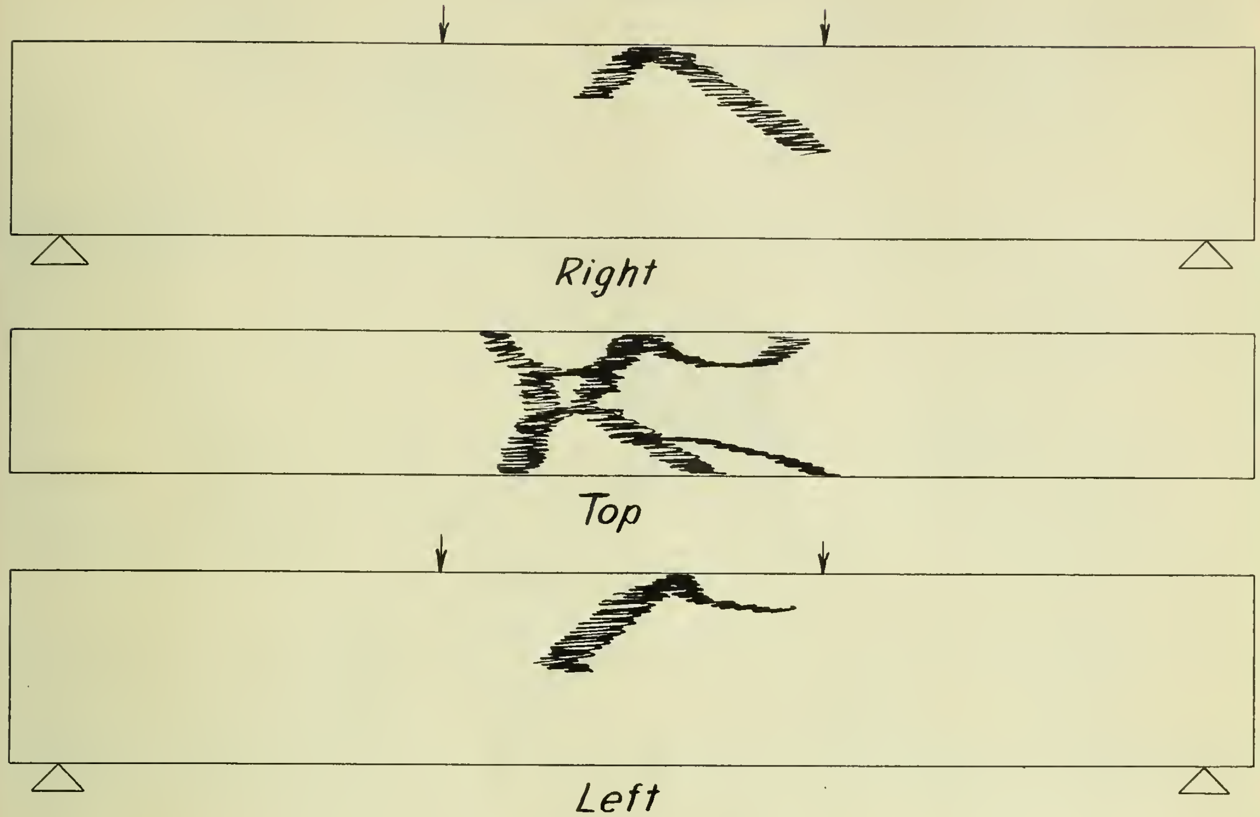

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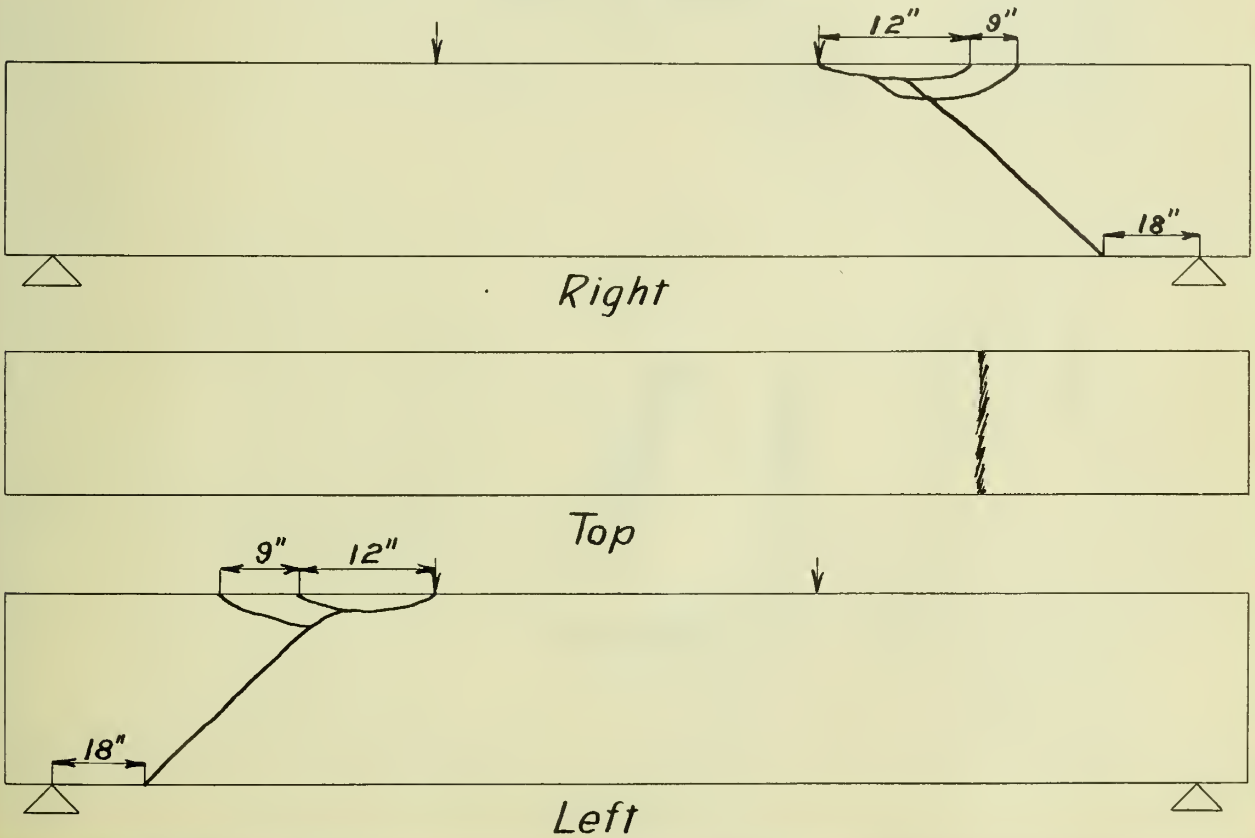
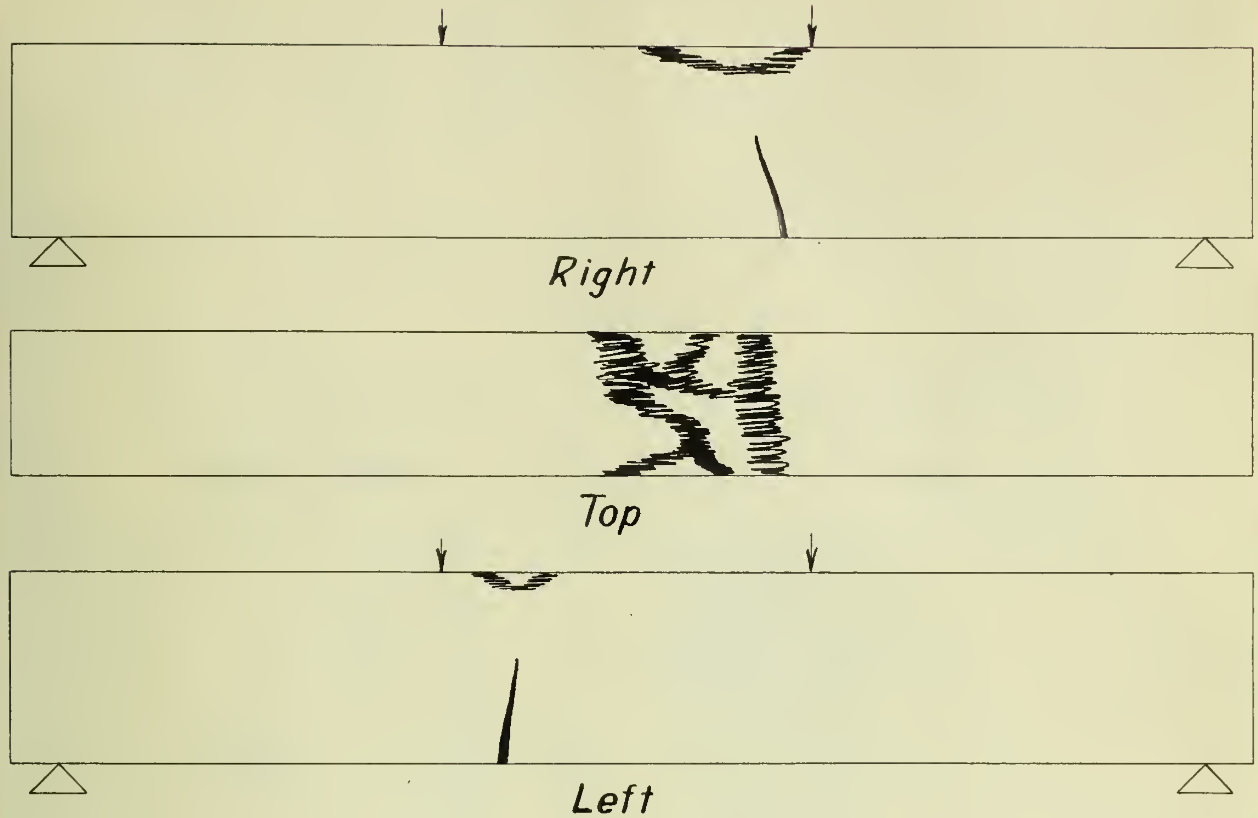


Beam 319.5



Beam 319.6

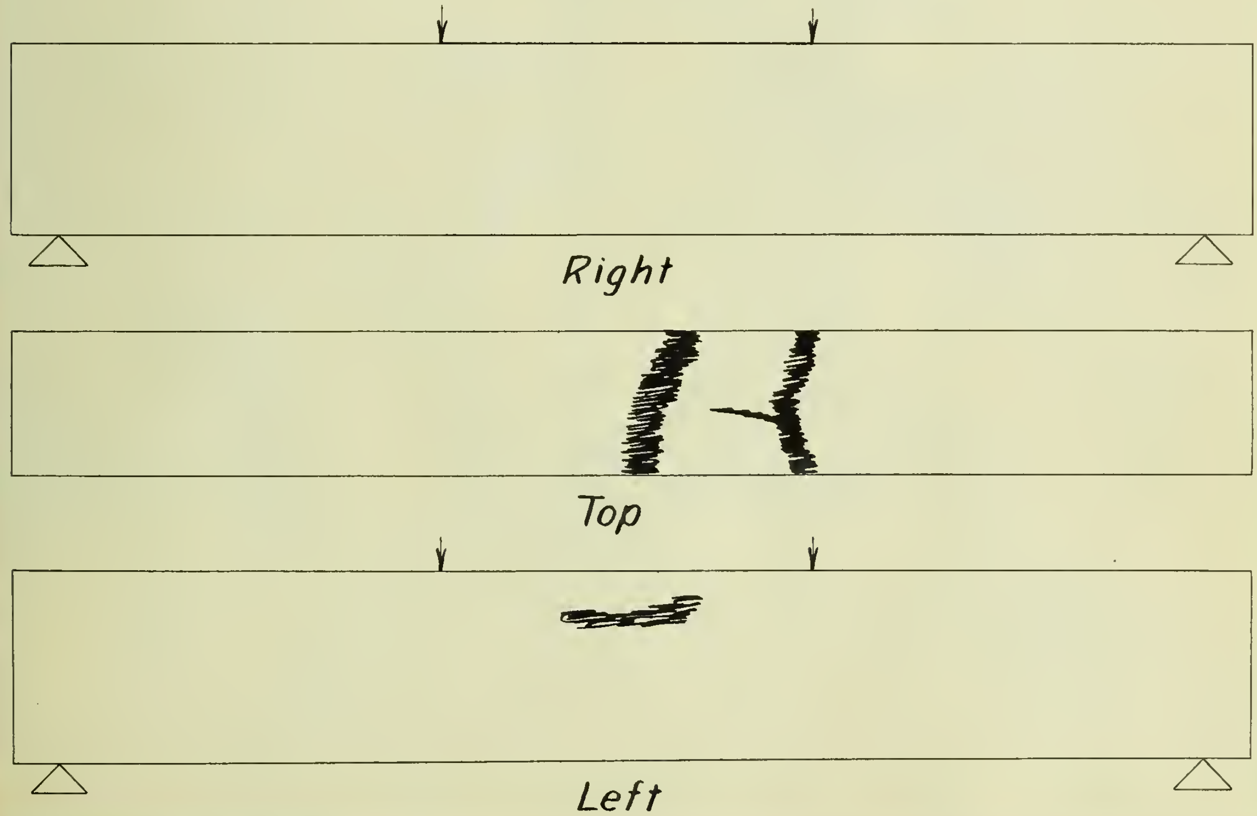


Table 39.

Table showing method of failure of different beams.

Series.	Number.	Age.	Method of failure.
311.	1.	7.	Compression.
	2.	7.	Compression.
	3.	7.	Compression.
	5.	7.	Compression.
	6.	7.	Diagonal Tension.
	7.	7.	Compression.
	8.	7.	Compression.
312.	1.	14.	Compression.
	2.	14.	Compression.
	3.	14.	Tension.
	5.	14.	Compression.
	6.	14.	Compression.
	7.	14.	Diagonal Tension.
313.	5.	24.	Tension.
	6.	77.	Tension.
314.	1.	63.	Tension.
	2.	63.	Diagonal Tension.
	5.	67.	Tension.
	6.	63.	Tension.
315.	5.	4.	Compression.
316.	5.	7.	Tension.
	6.	7.	Tension.
317.	5.	14.	Tension.
	6.	14.	Tension.
318.	5.	7.	Compression.
	6.	7.	Diagonal Tension.
319.	5.	17.	Tension.
	6.	14.	Compression.

Figure 4.

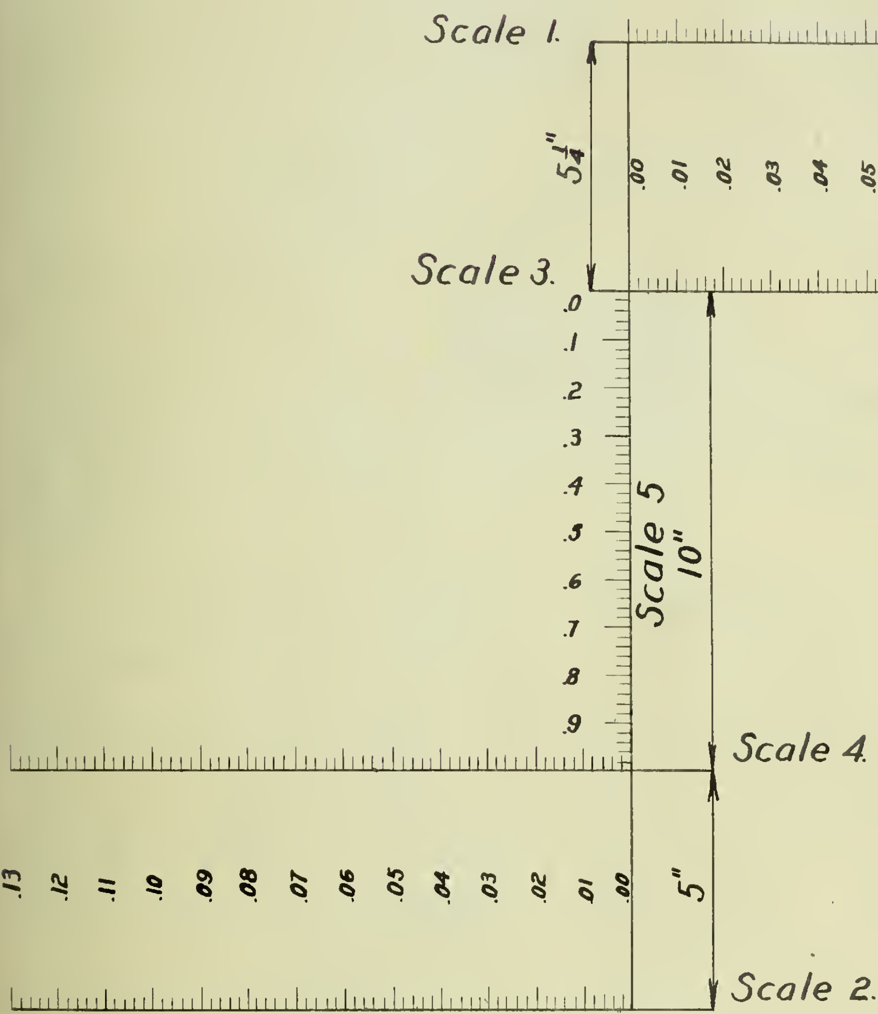


Diagram for the Graphical Solution
of the
Unit Deformations
in the
Upper Fiber of the Concrete, and the Steel
and the
Determination of the Neutral Axis.

crushing deformation, equal to 1/4, which was the value of "q" used in designing the beams. The load giving this deformation was taken from the upper fiber curve, and the value of "k", the ratio of the distance between the compression face and the neutral axis to the depth of the beam, for this load was taken from the neutral axis curve. Then the value of "n", the ratio of the modulus of elasticity of the steel to the modulus of elasticity of the concrete, was determined for this value of "k" by means of the formula;-

$$k = \sqrt{\frac{24}{11}pn + \frac{144}{121}p^2n^2} - \frac{12}{11}pn.$$

in which "p" = the ratio of area of metal reinforcement to area of concrete above the center of reinforcement. Then using the formula;-

$$E_c = \frac{E_s}{n}$$

the modulus of elasticity of the concrete was computed. To determine the stress in the steel the formula;- $M = Afd'$ was used, in which "M" = the bending moment developed in the beam: "A" = the cross section of the metal reinforcement: "d'" = the distance from the center of reinforcement to the center of gravity of the compressive forces: and "f" = the stress in the steel. The stress in the concrete was determined by the formula ;-

$$C = \frac{2Af}{kbd}\left(\frac{1-\frac{1}{2}q}{1-\frac{1}{3}q}\right).$$

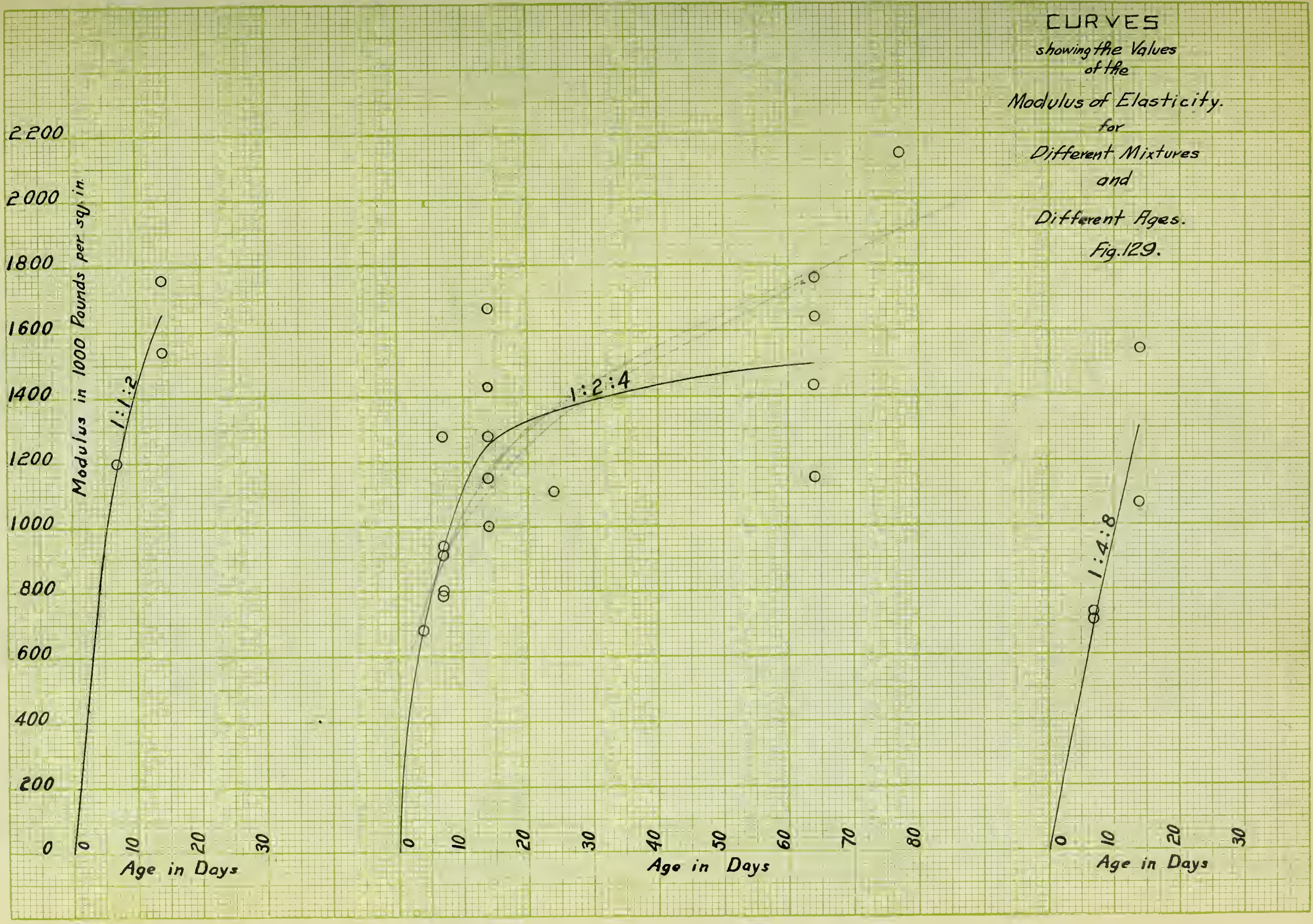
Besides the extensometer readings and the computations made from them, deflections were taken at the center of the beam by means of a string and scale as shown in Fig. 2, page 20 . A deflection curve was then plotted for each beam using the applied load in pounds as ordinates and the deflections as abscissae.

Table 29. Computed Data.

Beam.	Mixture.	Maximum. Stress in Steel.	Maximum Stress in Concrete.	Applied Load in Pounds.	Neutral Axis.	Concrete:- Modulus of Elasticity.	Age.
311-1	1-2-4	14250.	334.	2500.	.65	800000.	7.
-2	"	21300.	554.	4000.	.56	940000.	7.
-3	"	24200.	647.	4000.	.58	910000	7.
-5	"	12900.	310.	2200.	.68	790000.	7.
-6	"	24800.	?	5000.	.50	1280000.	7.
-7	"	22200.	532.	4000.	.58	910000.	7.
-8	"	21600.	532.	4000.	.60.	880000.	7.
312-1	"	35400.	920.	5000.	.55	1000000.	14.
-2	"	35800.	1080.	5500.	.52	1150000.	14.
-3	"	32800.		5000.	.48	1430000.	14.
-5	"	32200.	850.	4800.	.55	1000000.	14.
-6	"	30600.	953.	4800.	.50	1280000.	14.
-7	"	28400.	1040. ?	5500.	.46	1670000.	14.
313-5	"	35000.	1260.	6000.	.53	1110000.	24.
-6	"	39500.		8000.	.42	2140000.	77.
314-1	"	41000.		7000.	.45	1760000.	63.
-2	"	36400.	?	6000.	.48	1430000.	63.
-5	"	39500.	?	6800.	.52	1150000.	67.
-6	"	42000.		8000.	.46	1640000.	63.
315-5	"	11000.	236.	1700.	.74	680000.	4.
316-5	1-1-2	37000.		6000.	.51	1200000.	7.
-6	"	35000.		5500.	.51	1200000	7.
317-5	"	40300.		6400.	.45	1760000.	14.
-6	"	36900.		7000.	.47	1540000.	14.
318-5	1-4-8	16400.	348.	2500.	.72	710000.	7.
-6	"	7750.	226.	2000.	.64	732000.	7.
319-5	"	33200.		6000.	.47	1540000.	17.
-6	"	12900.	350.	2900.	.53	1070000.	14.

PART Vl.

DISCUSSION.


CURVES
showing the Values
of the
Modulus of Elasticity.
for
Different Mixtures
and
Different Ages.
Fig.129.
Modulus in 1000 Pounds per sq. in.
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1:1:2
1:2:4
1:4:8
0
10
20
30
40
50
60
70
80
Age in Days
EUGENE DIETZGEN CO., CHICAGO

PART VI. DISCUSSION.

After the modulus of elasticity had been computed,as shown on page ,for each beam and the results tabulated,curves were plotted,one for each mixture,with the moduli of elasticity as ordinates and the ages as abscissae. See Fig.129,page 51.

In the 1-2-4 series the modulus as determined for one 4 day beam was 680000. lb. per sq. in. At 7 days the average from 7 tests was 930000. lb. per sq. in. At 14 days the average from 6 tests was 1250000. lb. per sq. in. and at 64 days the average from 4 tests was 1500000. lb. per sq. in. This shows that the modulus increases with the age of the beam,though the increase varies by no means directly with the age. During the first 14 days the increase was very rapid;but after that the curve begins to fall off and at 60 days the increase in the modulus was comparatively small.

The tests in the 1-1-2 series,as was expected,gave much higher results at the same ages than the 1-2-4 series. The modulus at 7 days,being the average of two tests,gave 1200000. lb. per sq. in. and the modulus at 14 days,being the average of two tests, gave 1650000. lb. per sq. in. This shows that the increase was very rapid during the first 14 days,but since there were no further tests in this series the action after this time could not be determined.

The tests of the 1-4-8 series gave smaller values for the modulus for corresponding ages than either one of the other two mixtures;but nevertheless they show that the increase in the modulus was very rapid during the first 14 days. The average from two tests at 7 days was 721000. lb. per sq. in. and the average

from two tests at 14 days was 1300000. lb. per sq. in.

As tests in the three different mixtures were made only up to 14 days,the results past that age can not in general be determined,though the one series tested shows a marked decrease in the rate of increase after 14 days. The general results, however,from these tests show that the modulus of elasticity increases very rapidly during the first 14 days,the increase from 7 to 14 days being from 30 to 35 % of the value at 7 days.

Upon comparing the modulus curves for the different mixtures the richer mixtures were found to give much higher values for the modulus at the same ages. This shows that,at corresponding ages,the modulus of elasticity is higher for a rich mixture than it is for a poorer or leaner mixture.

The deflection curves show that the older the beams are,the stiffer they are. In the older beams the deflection curves are straighter and steeper and make a sharper turn at the maximum load. This is because the older beams do not deflect so much but give way more suddenly than the more unseasoned beams.

PART VII.

CURVES.

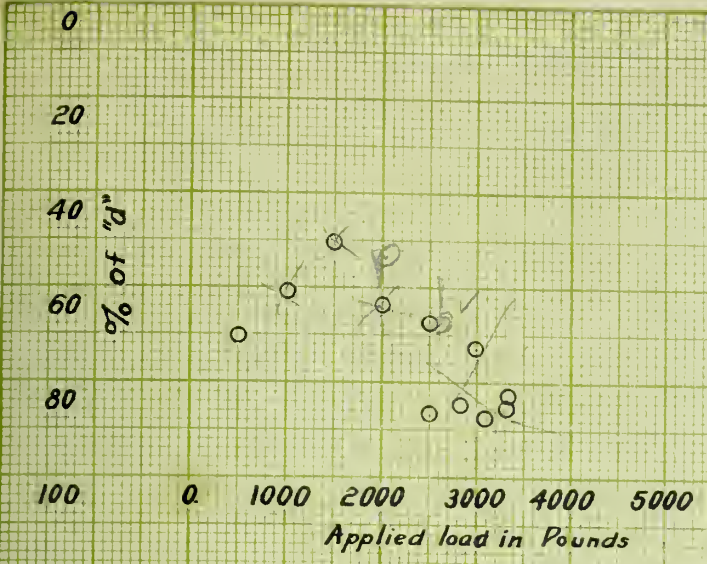
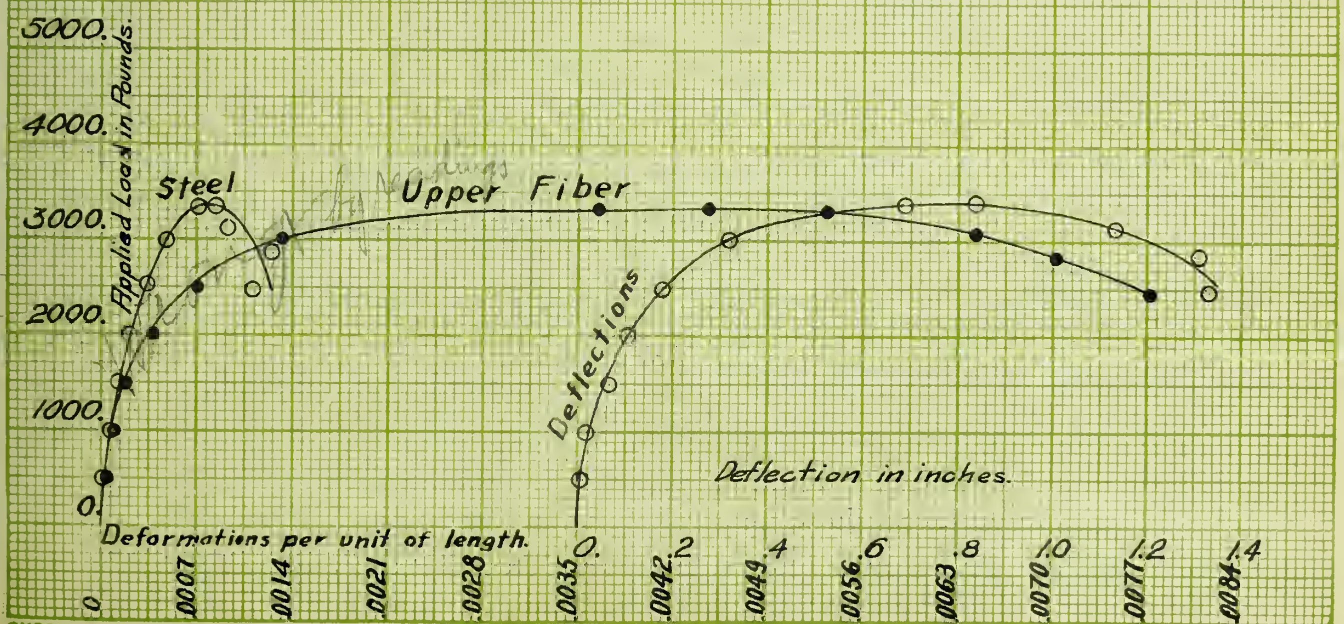
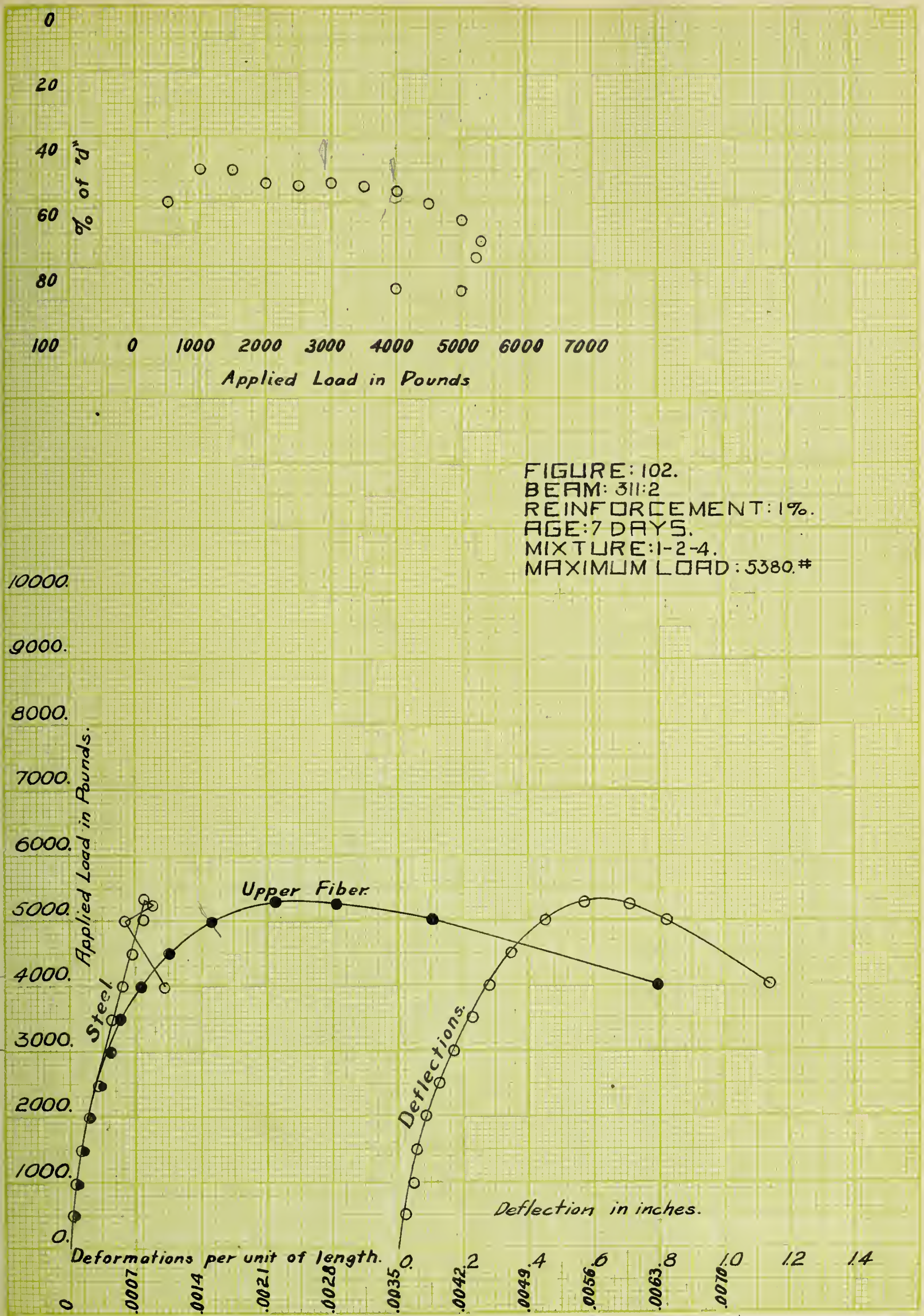


FIGURE: 101.
BEAM: 311:1
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 3370.#





0
20
40
60
80
100
% of "d"
0
1000
2000
3000
4000
5000
6000
7000
Applied Load in Pounds
FIGURE: 102.
BEAM: 311:2
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 5380.#
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Upper Fiber.
Steel.
Deflections.
Deflection in inches.
Deformations per unit of length.
0
.0007
.0014
.0021
.0028
.0035
.0042
.0049
.0056
.0063
.0070
0.
.2
.4
.6
.8
1.0
1.2
1.4

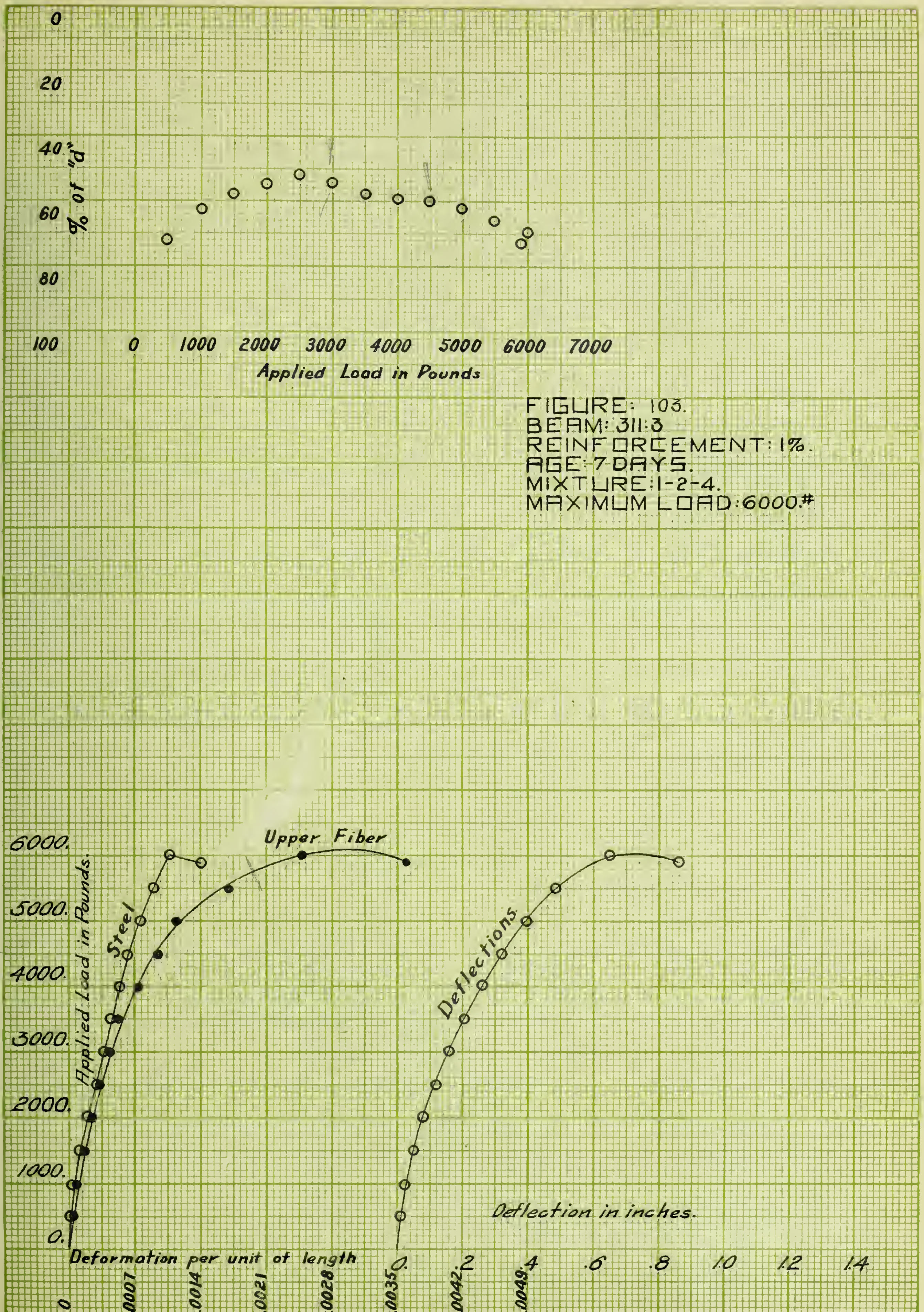
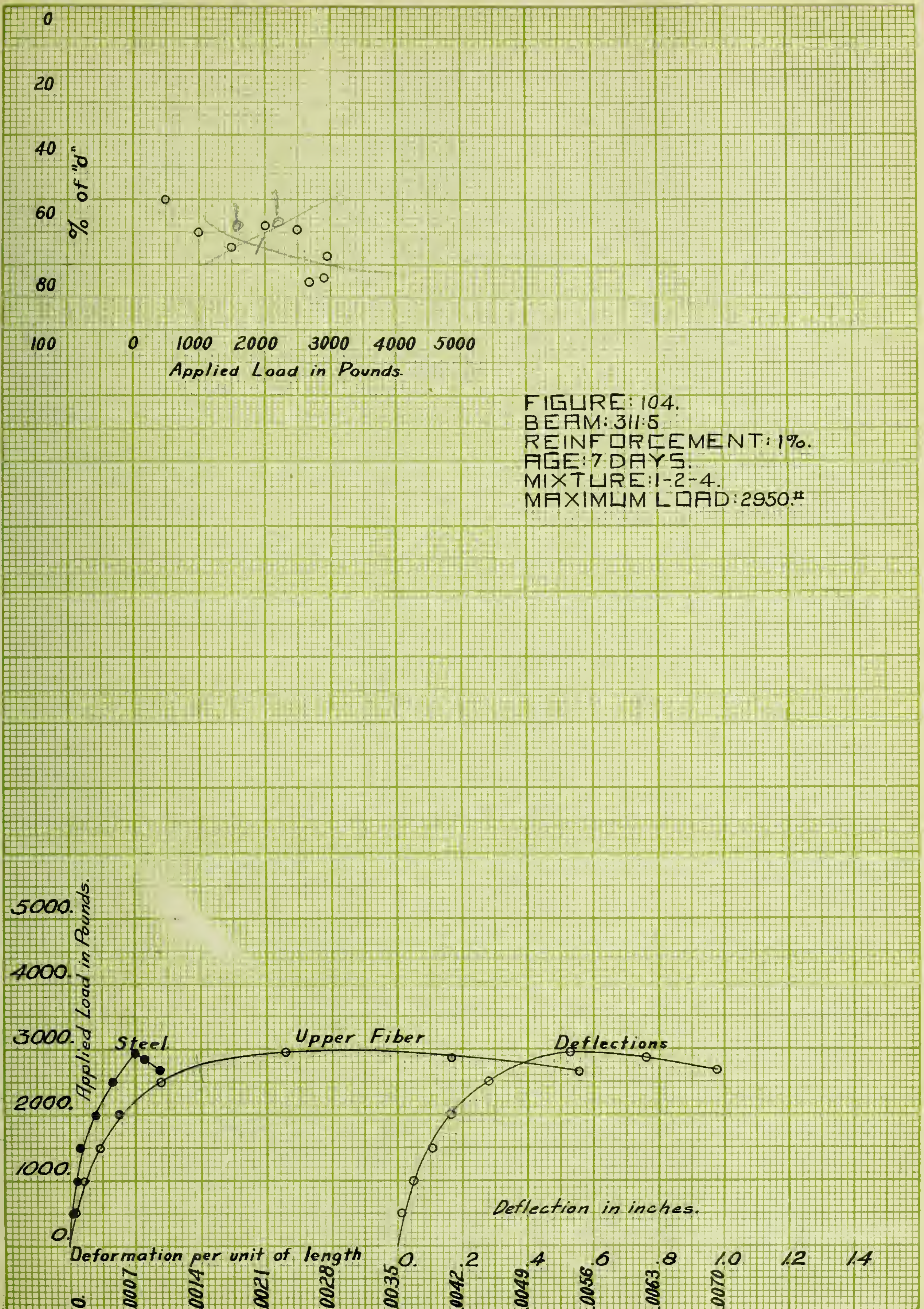
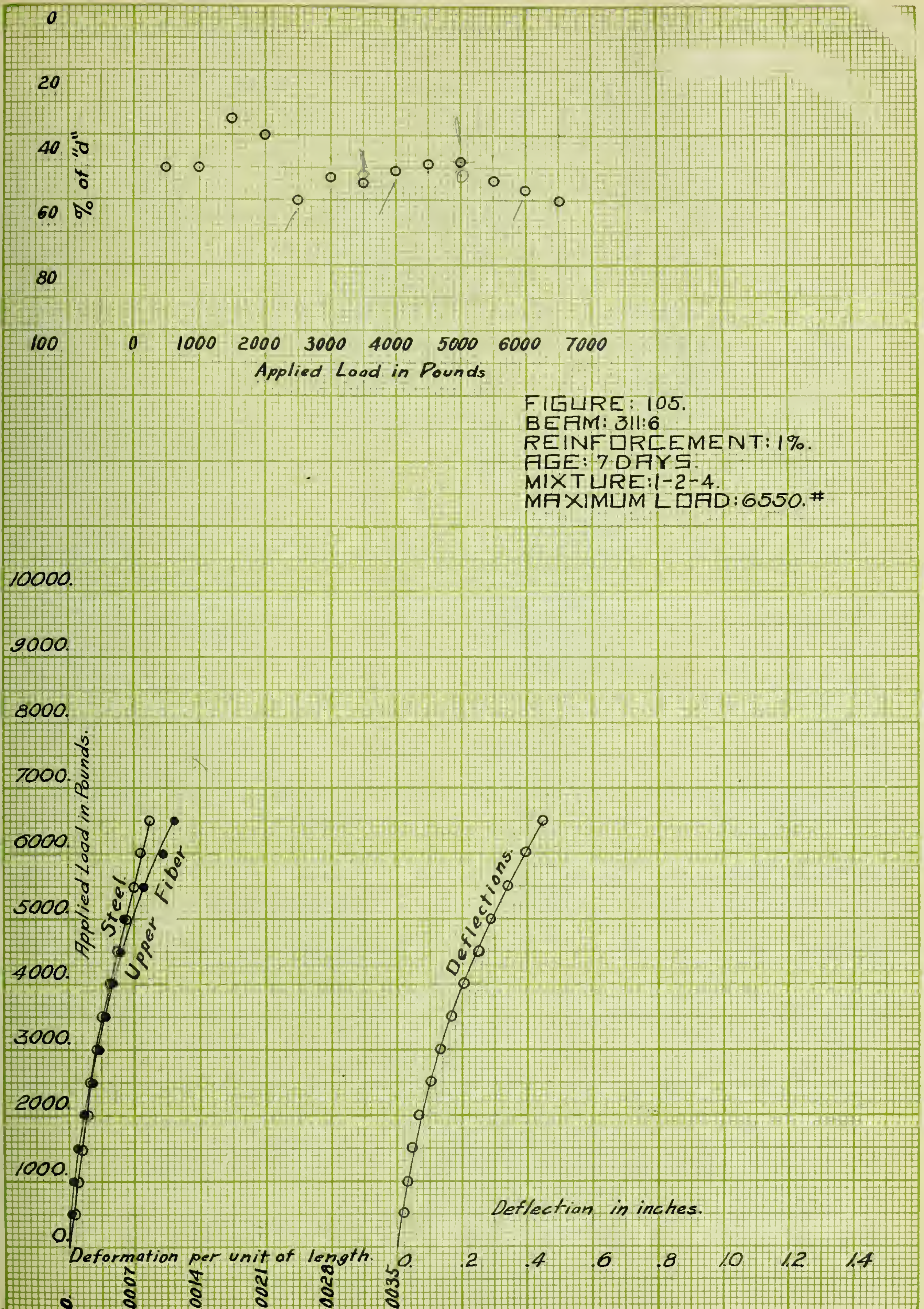


FIGURE: 103.
BEAM: 311-3
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 6000.#


0
20
40
60
80
100
% of "d"
0 1000 2000 3000 4000 5000
Applied Load in Pounds.
FIGURE: 104.
BEAM: 311:5
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 2950.#
5000.
4000.
3000.
2000.
1000.
0
Applied Load in Pounds.
Steel.
Upper Fiber
Deflections
Deflection in inches.
Deformation per unit of length
0. .0007 .0014 .0021 .0028 .0035 .0042 .0049 .0056 .0063 .0070
0. .2 .4 .6 .8 1.0 1.2 1.4



0
20
40
60
80
100
% of "d"
0 1000 2000 3000 4000 5000 6000 7000
Applied Load in Pounds
FIGURE: 105.
BEAM: 311:6
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 6550.#
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Steel.
Upper Fiber
Deflections.
Deflection in inches.
Deformation per unit of length.
0. .0007 .0014 .0021 .0028 .0035
0. .2 .4 .6 .8 1.0 1.2 1.4

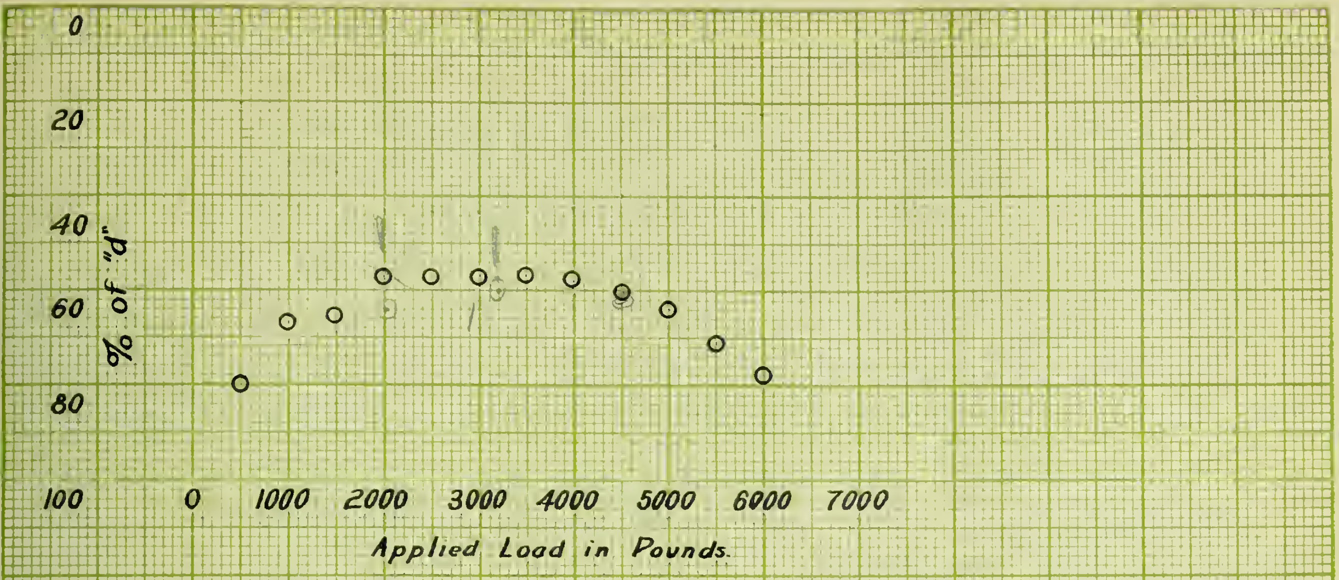


FIGURE: 106.
BEAM: 311:7
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 5150.#

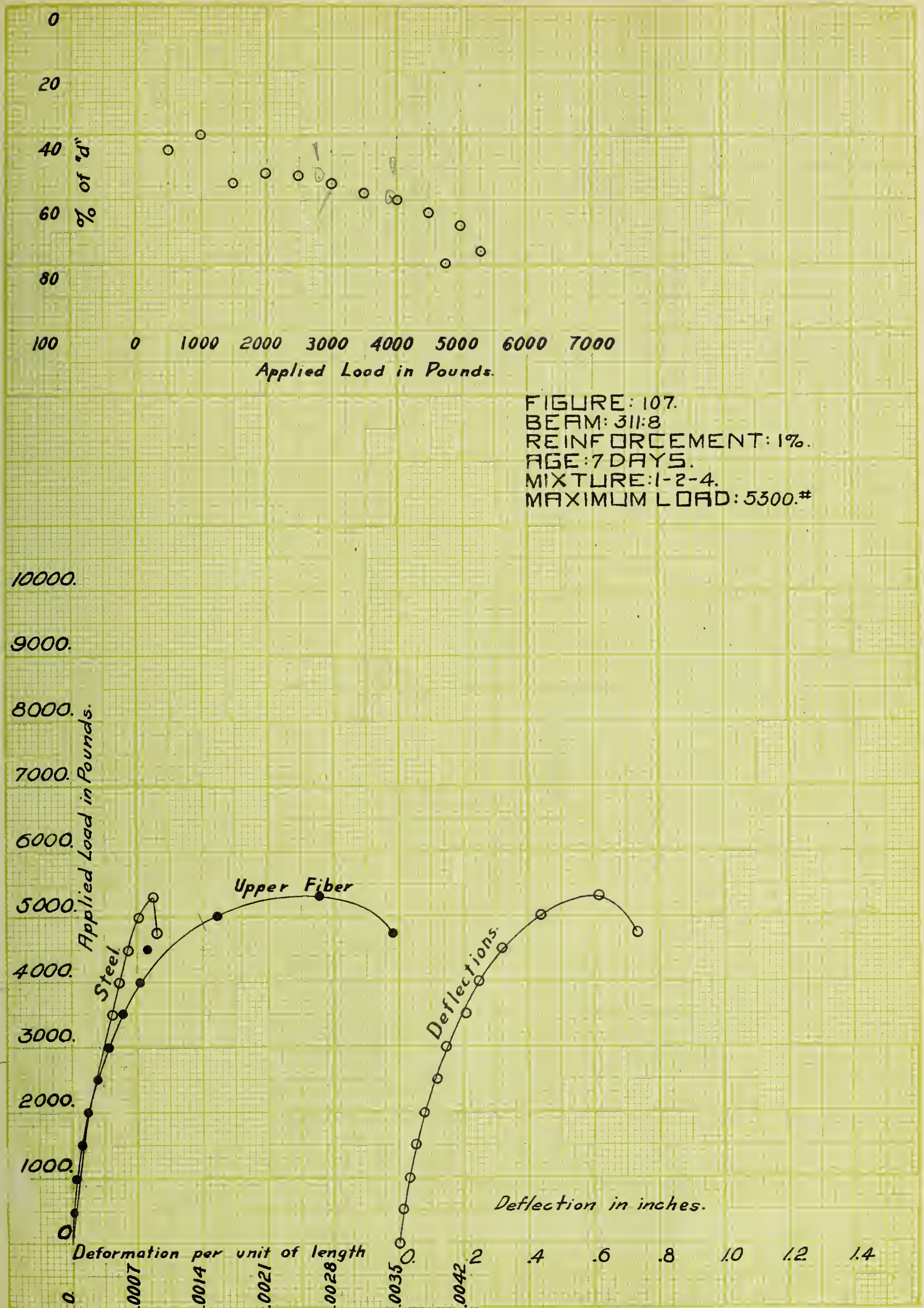
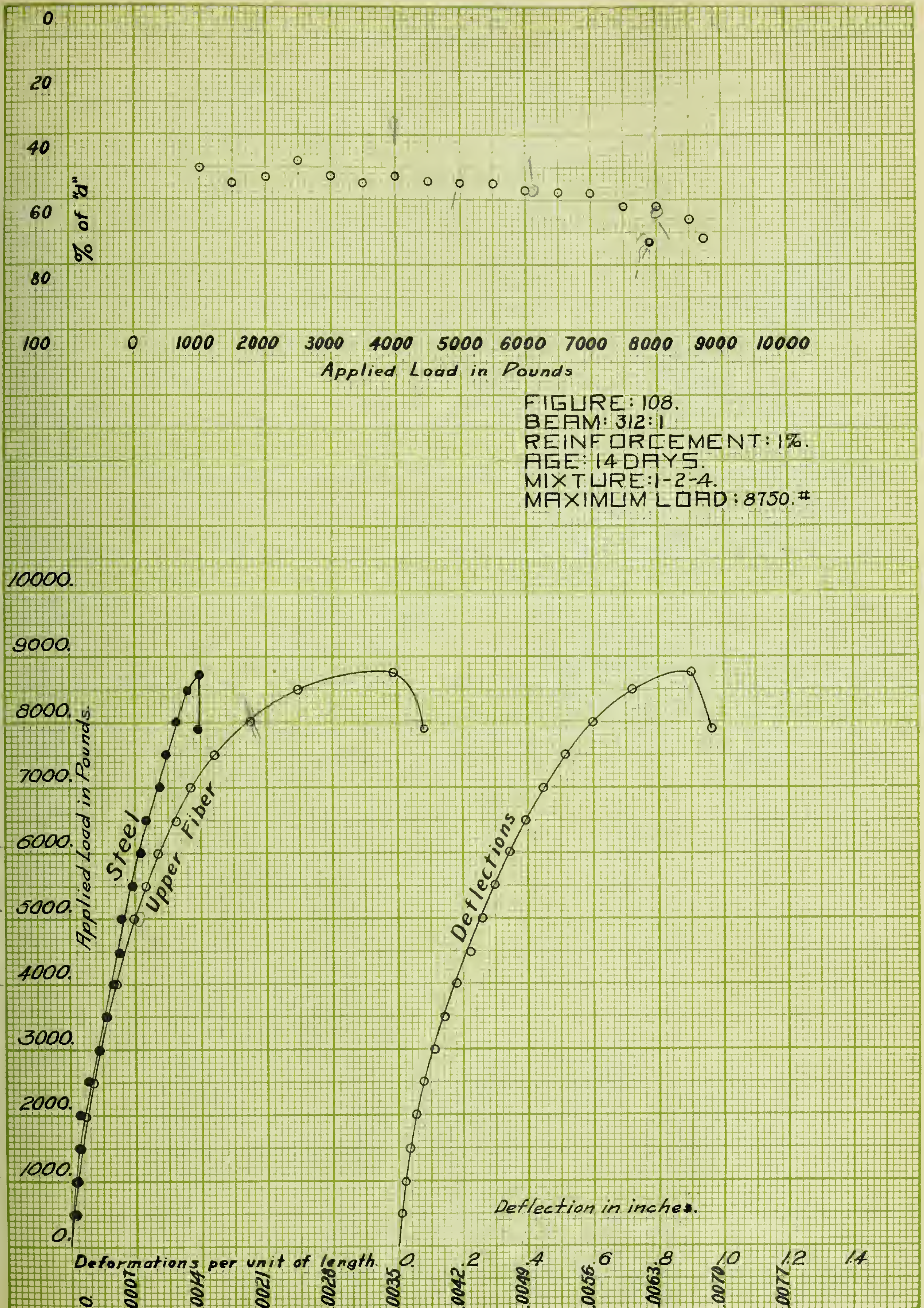
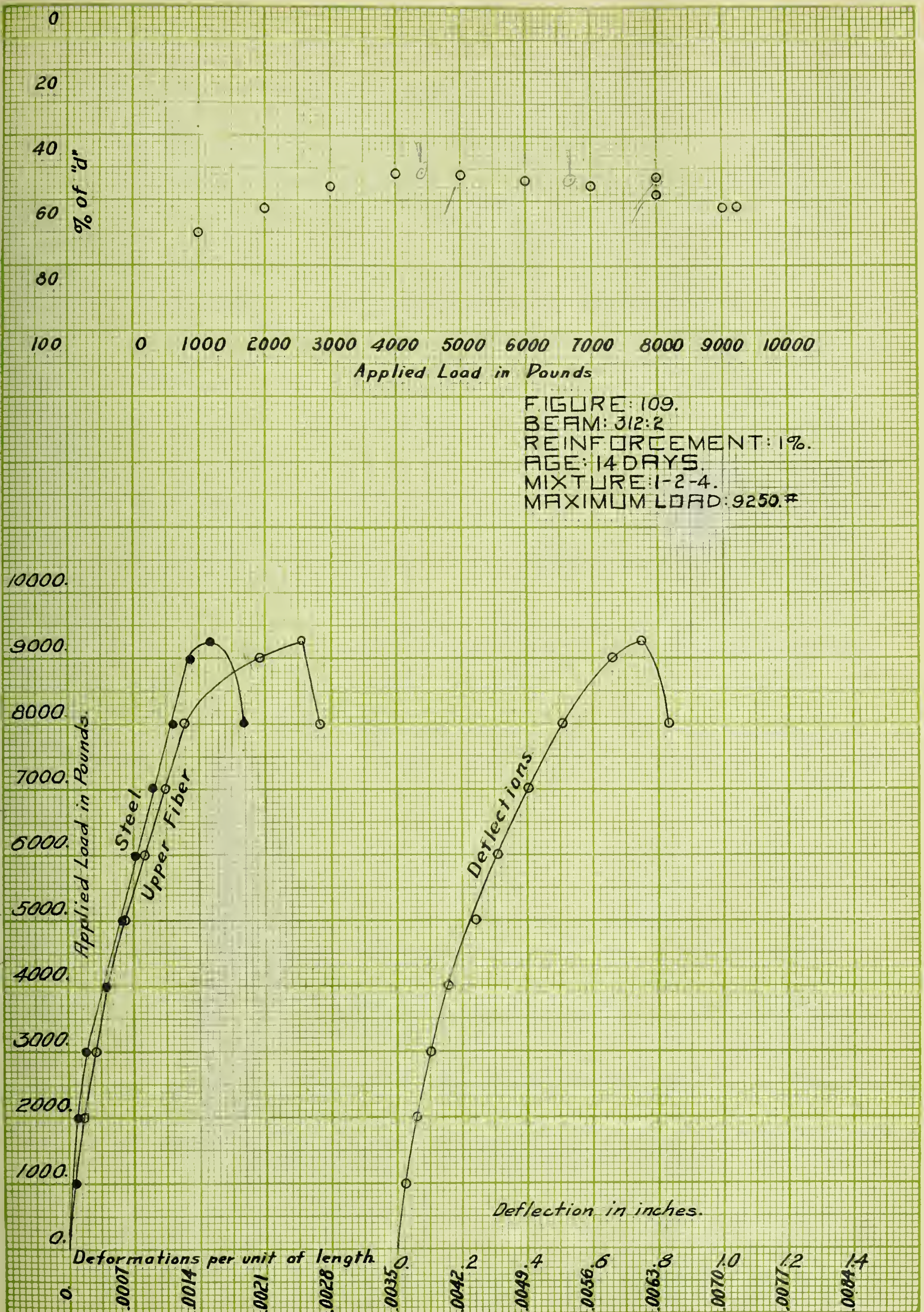


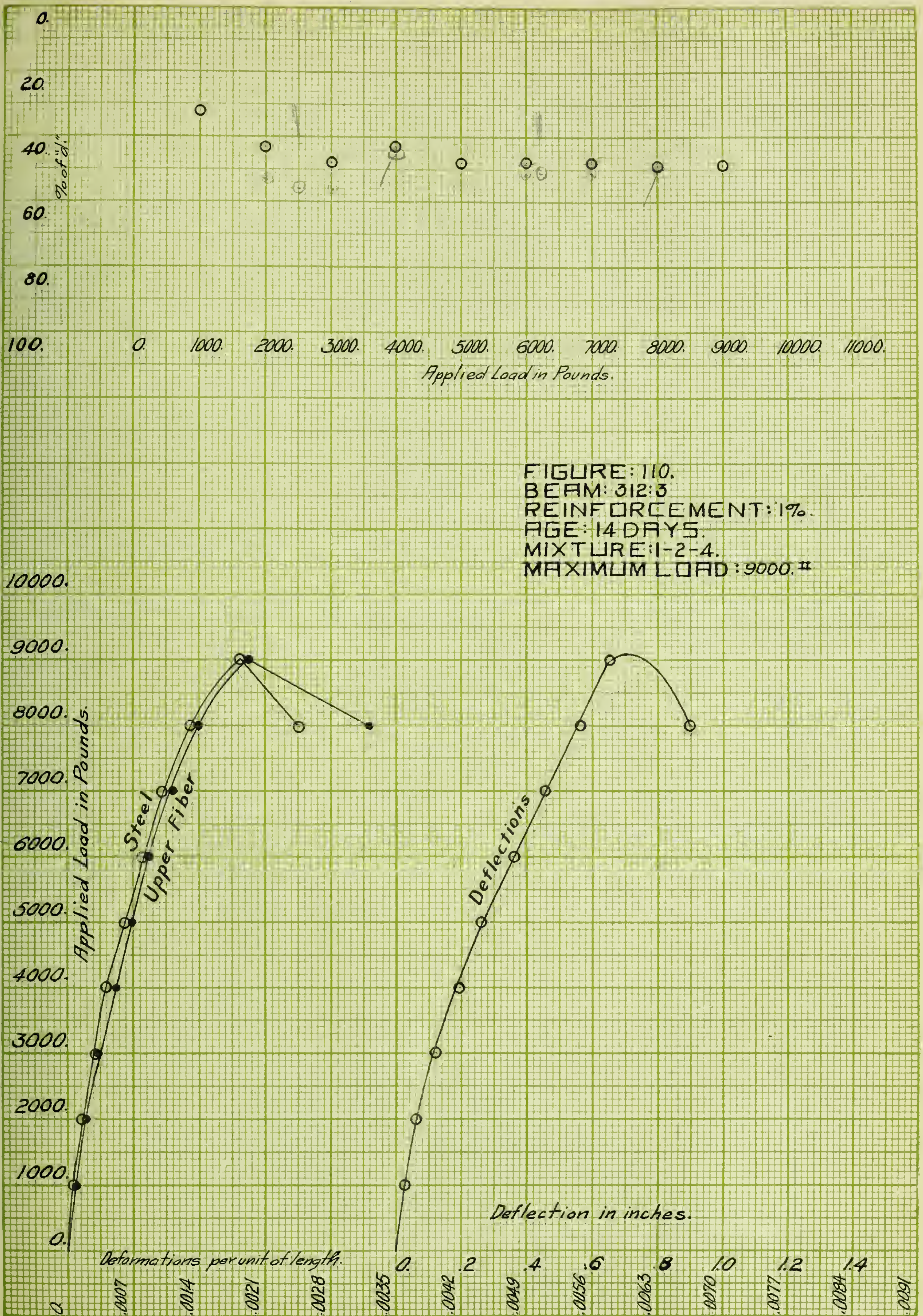
FIGURE: 107.
BEAM: 311:8
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 5300.#



0
20
40
60
80
100
% of "d"
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Applied Load in Pounds
FIGURE: 108.
BEAM: 312:1
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 8750.#
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds
Steel
Upper Fiber
Deflections
Deflection in inches.
Deformations per unit of length
0. .2 .4 .6 .8 1.0 1.2 1.4
0. .0007 .0014 .0021 .0028 .0035 .0042 .0049 .0056 .0063 .0070 .0077



0
20
40
60
80
100
% of "d"
0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Applied Load in Pounds
FIGURE: 109.
BEAM: 312:2
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 9250.#
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Steel.
Upper Fiber
Deflections
Deflection in inches.
Deformations per unit of length.
0. .0007 .0014 .0021 .0028 .0035 .0042 .0049 .0056 .0063 .0070 .0077 .0084
0. .2 .4 .6 .8 1.0 1.2 1.4



% of "d".
0.
20.
40.
60.
80.
100.
0. 1000. 2000. 3000. 4000. 5000. 6000. 7000. 8000. 9000. 10000. 11000.
Applied Load in Pounds.
FIGURE: 110.
BEAM: 312:3
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 9000. #
Applied Load in Pounds.
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Steel
Upper Fiber
Deflections
Deflection in inches.
Deformations per unit of length.
0. .2 .4 .6 .8 1.0 1.2 1.4
0 .0007 .0014 .0021 .0028 .0035 .0042 .0049 .0056 .0063 .0070 .0077 .0084 .0091

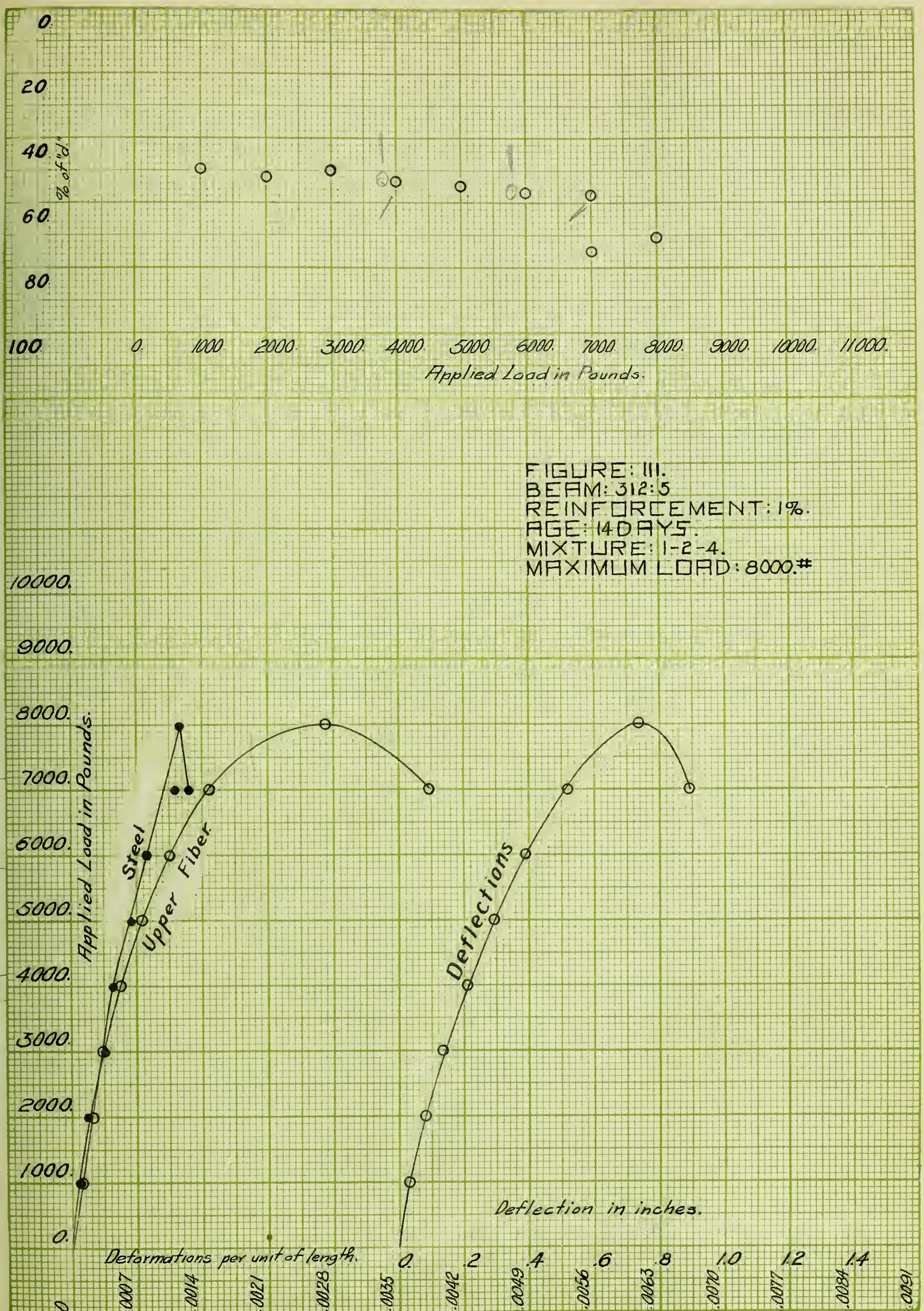


FIGURE: III.
BEAM: 312:5
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 8000.#

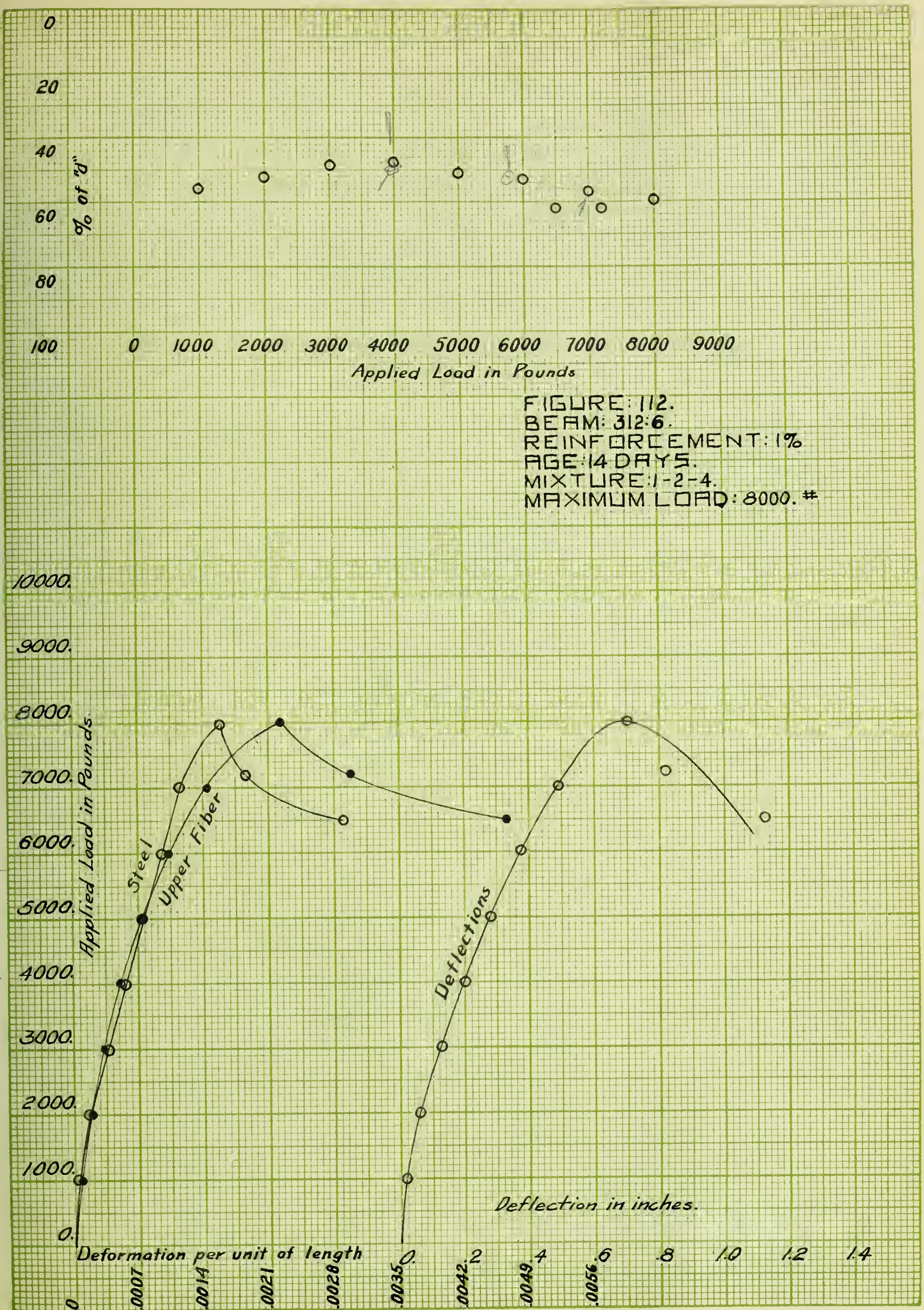


FIGURE: 112.
BEAM: 312:6.
REINFORCEMENT: 1%
AGE: 14 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 8000. #

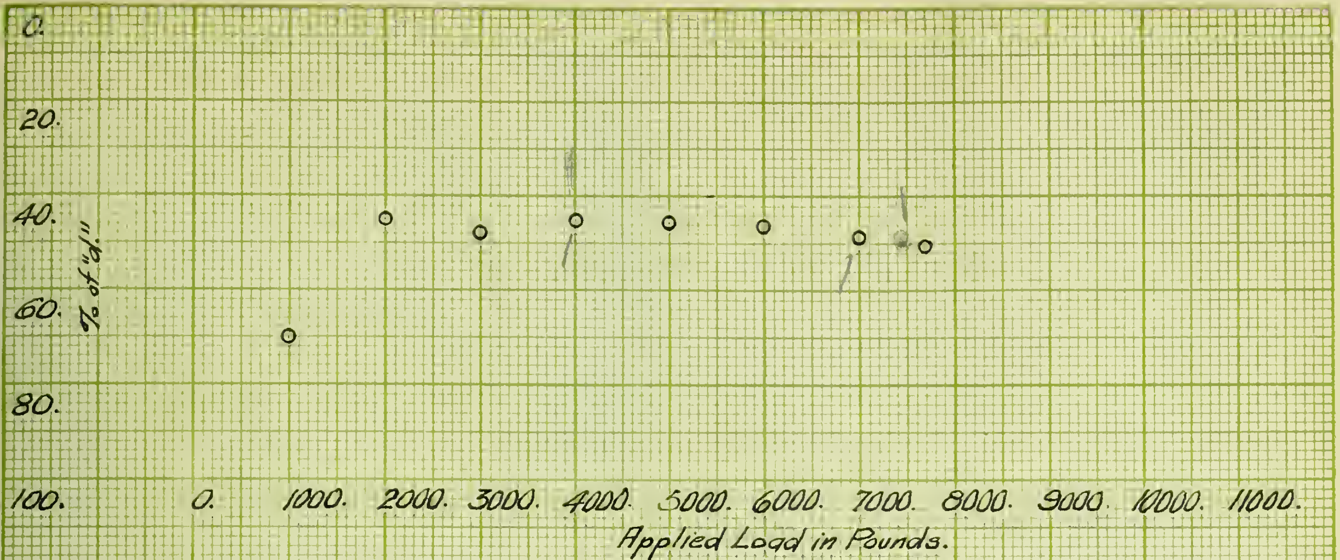
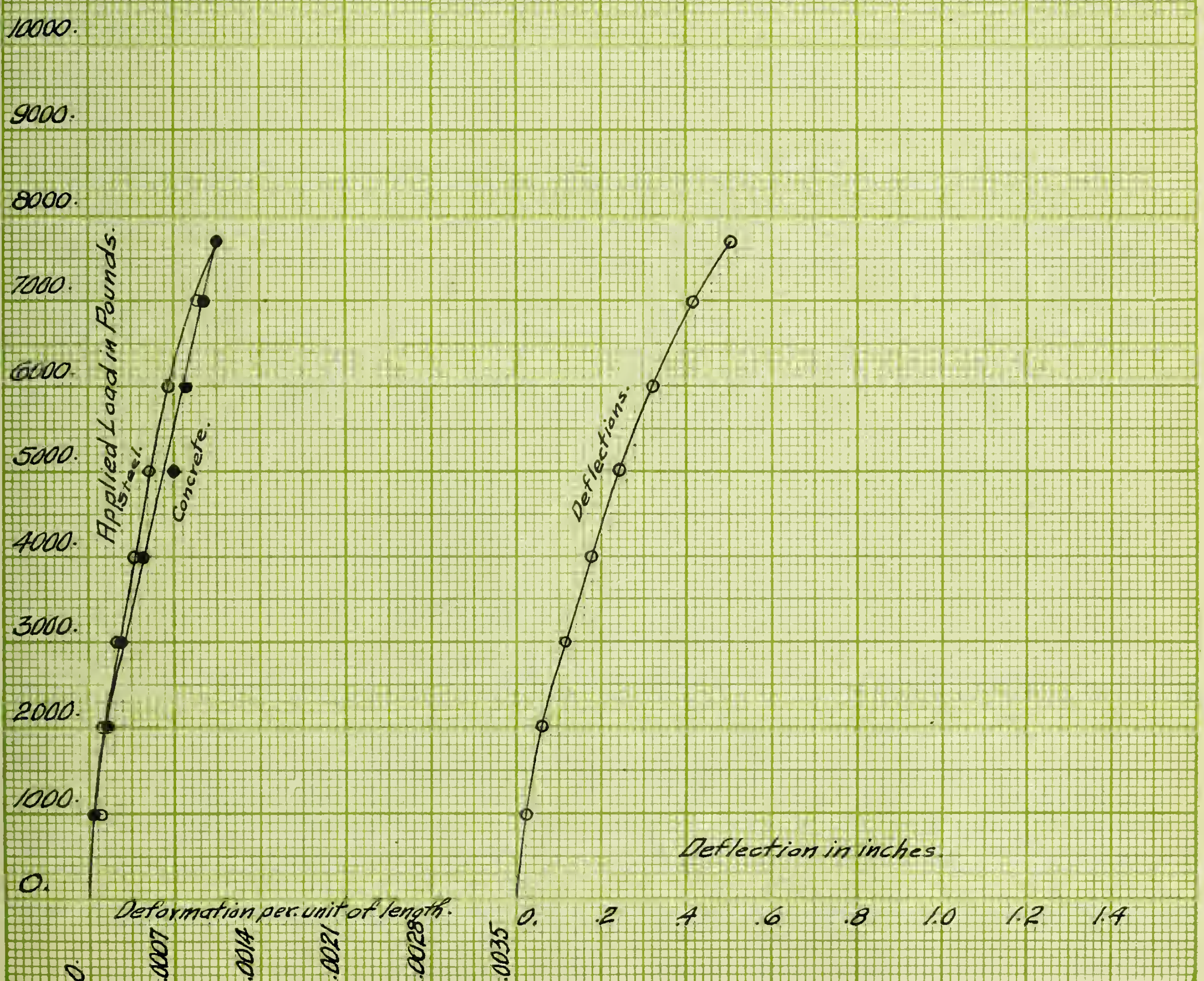
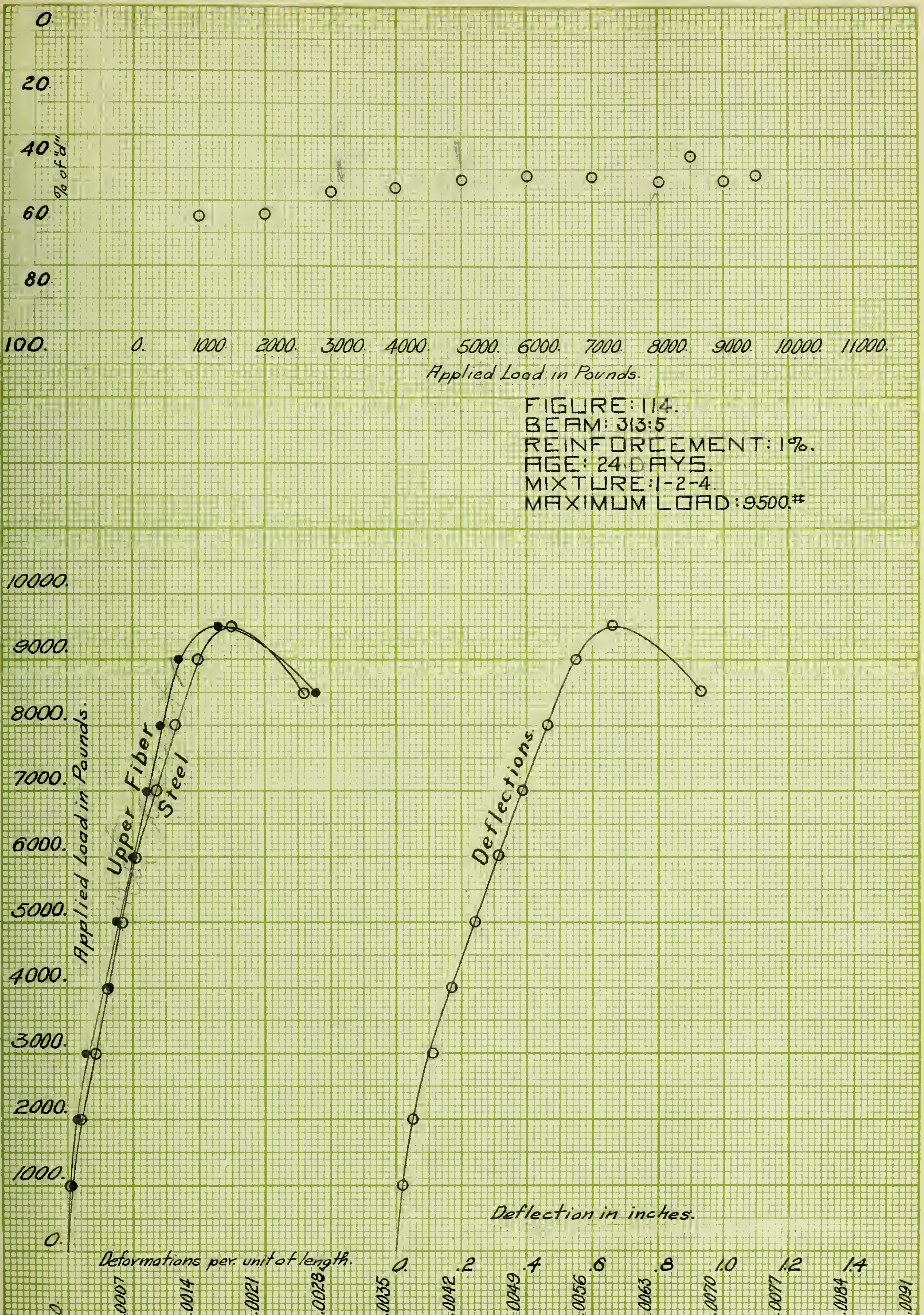
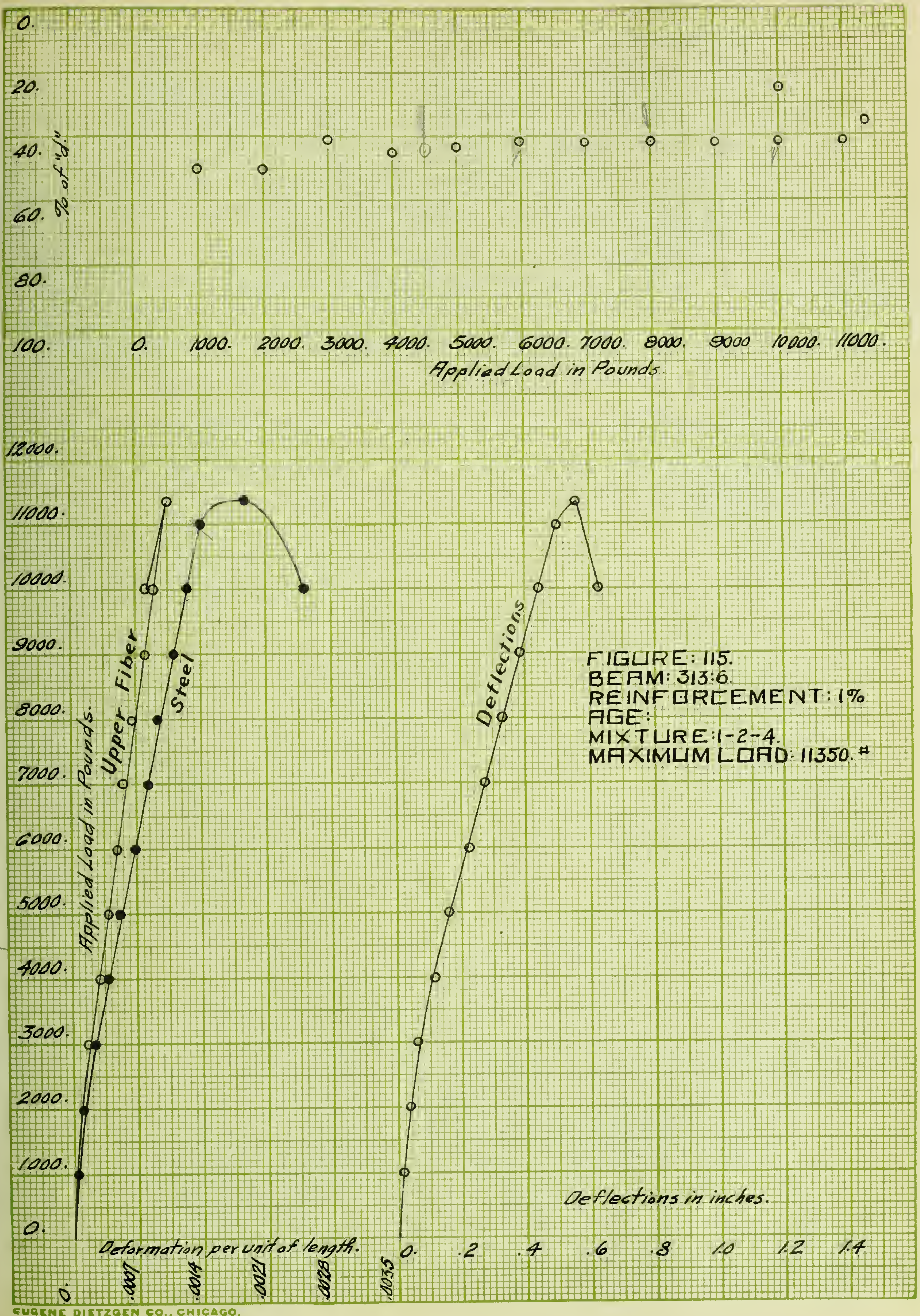


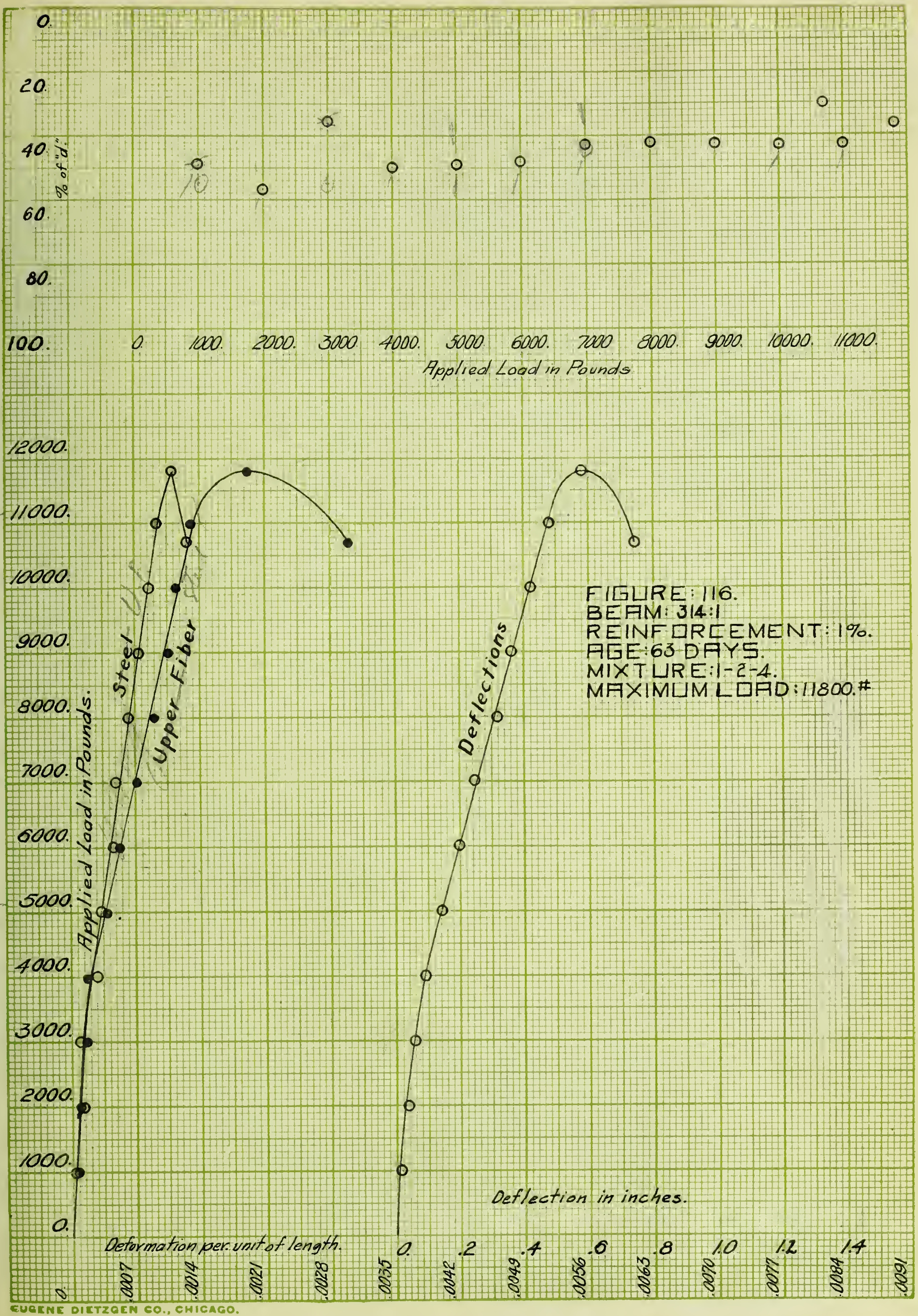
FIGURE: 113.
BEAM: 312:7
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 7700.#





EUGENE DIETZGEN CO., CHICAGO.


0.
20.
40.
60.
80.
100.
% of "d."
0.
1000.
2000.
3000.
4000.
5000.
6000.
7000.
8000.
9000
10000.
11000.
Applied Load in Pounds.
12000.
11000.
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Upper Fiber
Steel
Deflections
FIGURE: 115.
BEAM: 313:6.
REINFORCEMENT: 1%
AGE:
MIXTURE: 1-2-4.
MAXIMUM LOAD: 11350.#
Deflections in inches.
Deformation per unit of length.
0.
.0007
.0014
.0021
.0028
.0035
0.
.2
.4
.6
.8
1.0
1.2
1.4
EUGENE DIETZGEN CO., CHICAGO.



0.
20.
40.
60.
80.
100.
% of "d".
0
1000.
2000.
3000.
4000.
5000.
6000.
7000
8000.
9000.
10000.
11000.
Applied Load in Pounds
12000.
11000.
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Steel
Upper Fiber
Deflections
FIGURE: 116.
BEAM: 314:1
REINFORCEMENT: 1%.
AGE: 63 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 11800.#
Deflection in inches.
Deformation per unit of length.
0.
.2
.4
.6
.8
1.0
1.2
1.4
0
.0007
.0014
.0021
.0028
.0035
.0042
.0049
.0056
.0063
.0070
.0077
.0084
.0091
EUGENE DIETZGEN CO., CHICAGO.

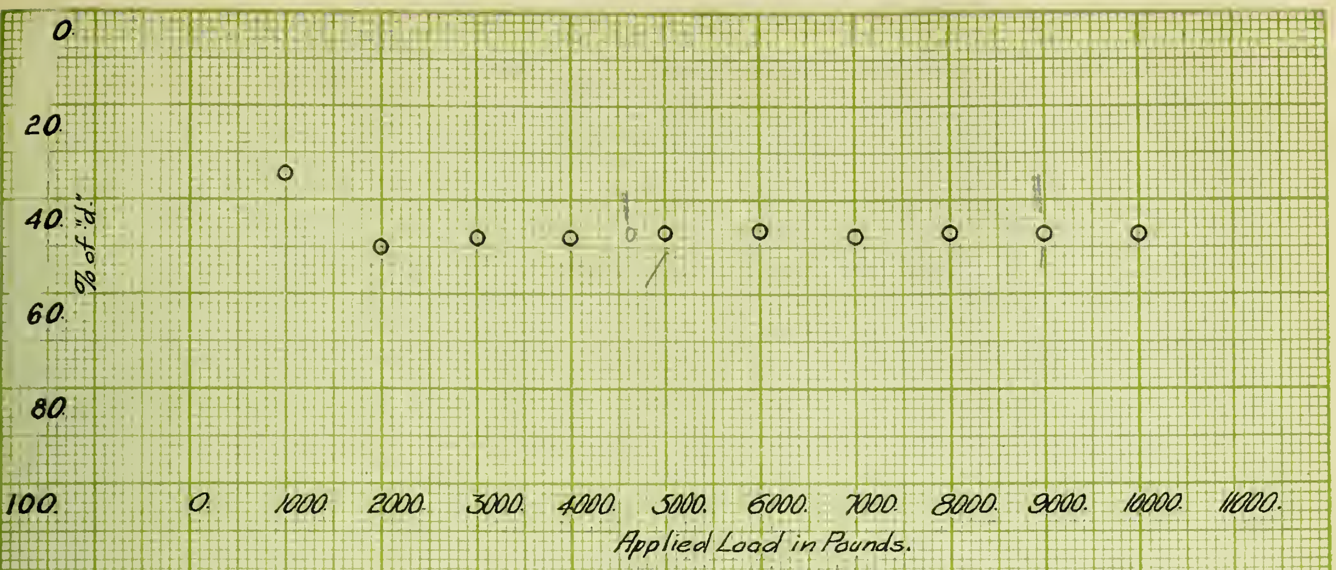
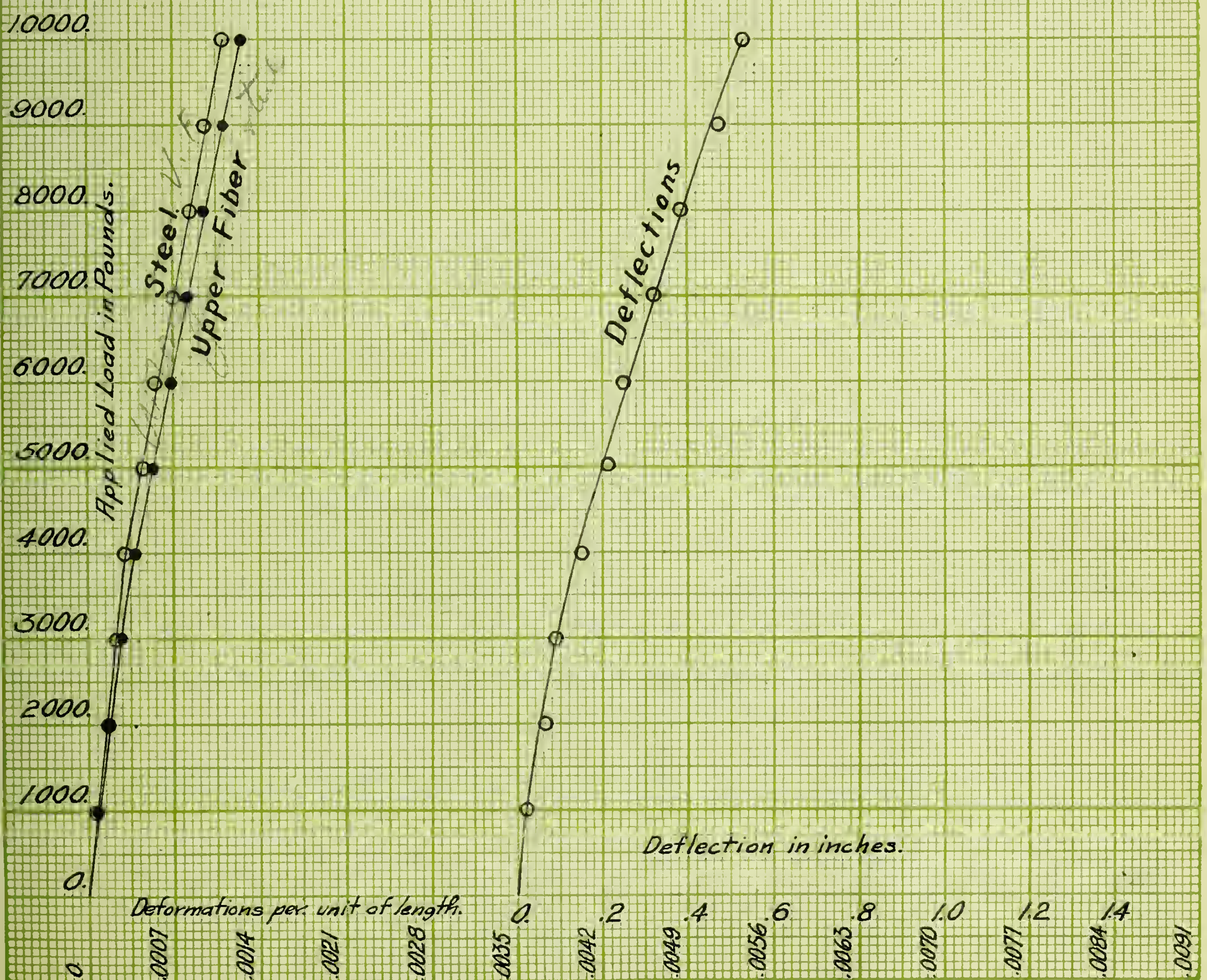
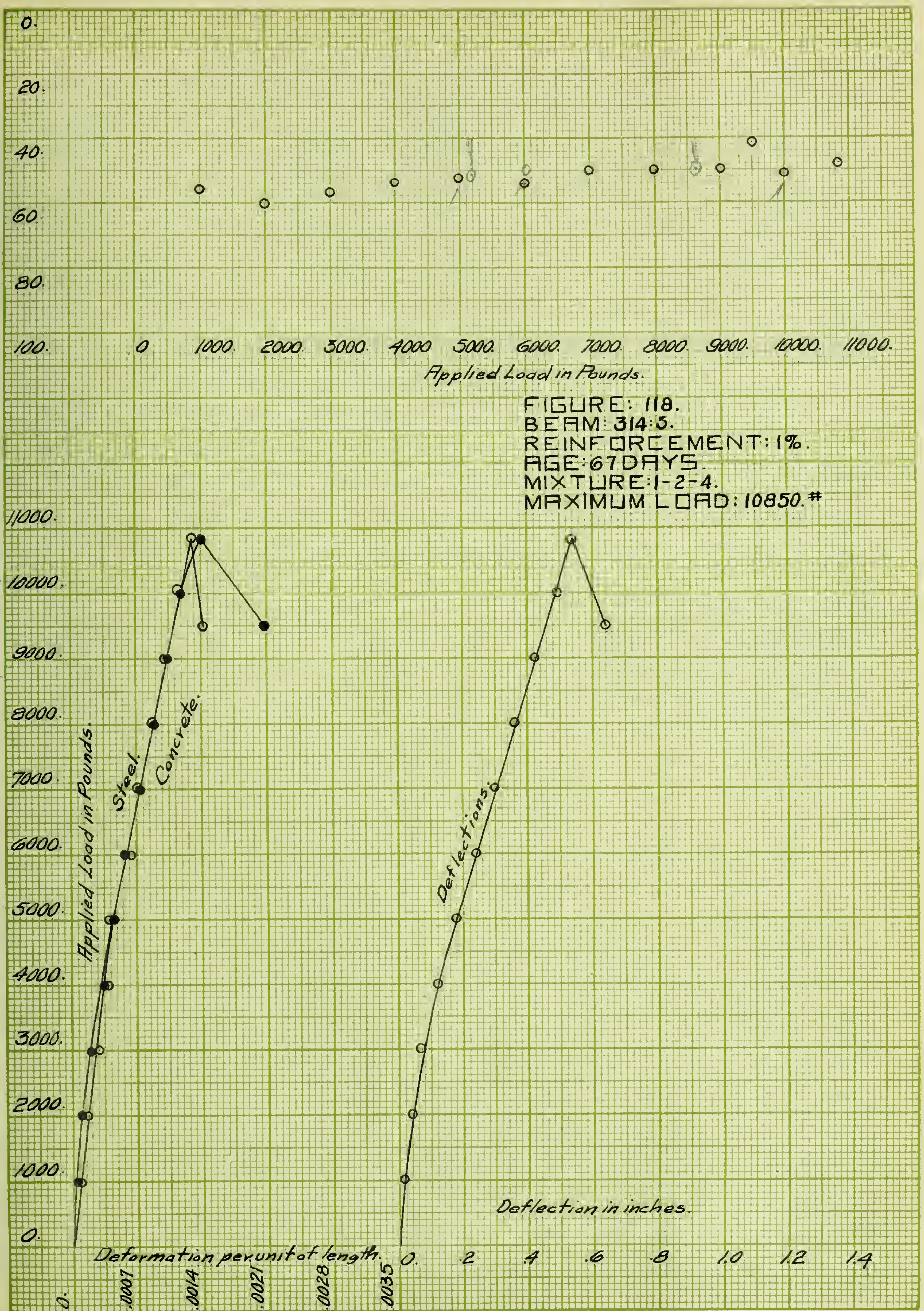
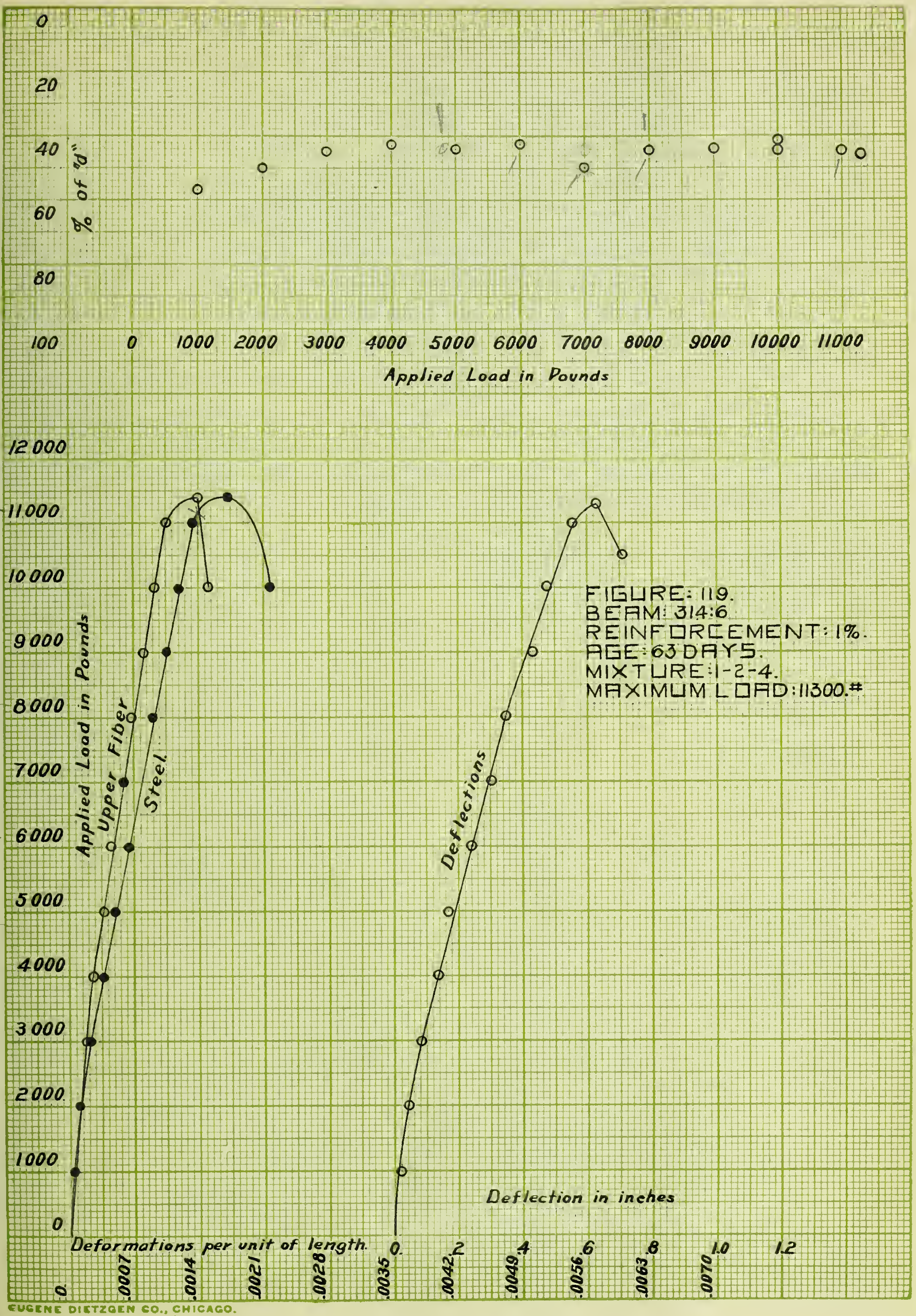


FIGURE: 117.
BEAM: 314.2
REINFORCEMENT: 1%
AGE: 63 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 10000.#




0.
20.
40.
60.
80.
100.
0
1000.
2000.
3000.
4000.
5000.
6000.
7000.
8000.
9000.
10000.
11000.
Applied Load in Pounds.
FIGURE: 118.
BEAM: 314:5.
REINFORCEMENT: 1%.
AGE: 67 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 10850.#
11000.
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Steel.
Concrete.
Deflections.
Deflection in inches.
Deformation per unit of length.
0.
.0007
.0014
.0021
.0028
.0035
0.
.2
.4
.6
.8
1.0
1.2
1.4



0
20
40
60
80
100
% of "d"
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
Applied Load in Pounds
12 000
11 000
10 000
9 000
8 000
7000
6 000
5 000
4000
3 000
2 000
1000
0
Applied Load in Pounds
Upper Fiber
Steel
Deflections
FIGURE: 119.
BEAM: 314:6
REINFORCEMENT: 1%.
AGE: 63 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 11300.#
Deflection in inches
Deformations per unit of length.
0.
.2
.4
.6
.8
1.0
1.2
0.
.0007
.0014
.0021
.0028
.0035
.0042
.0049
.0056
.0063
.0070
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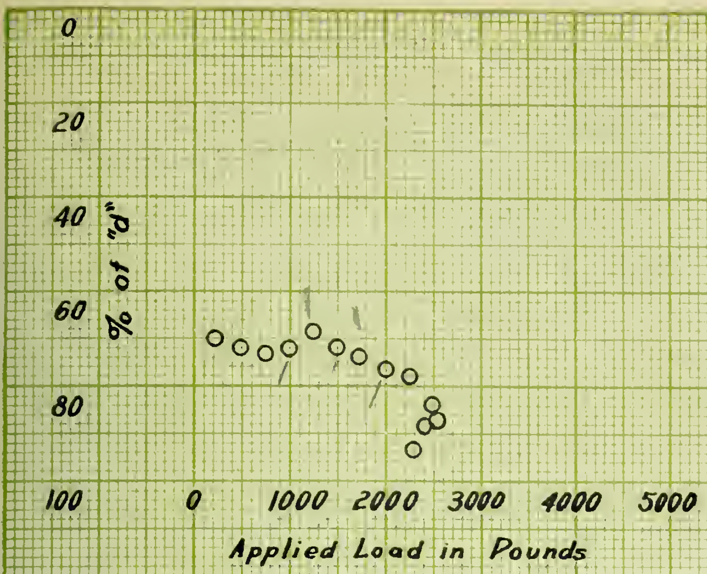
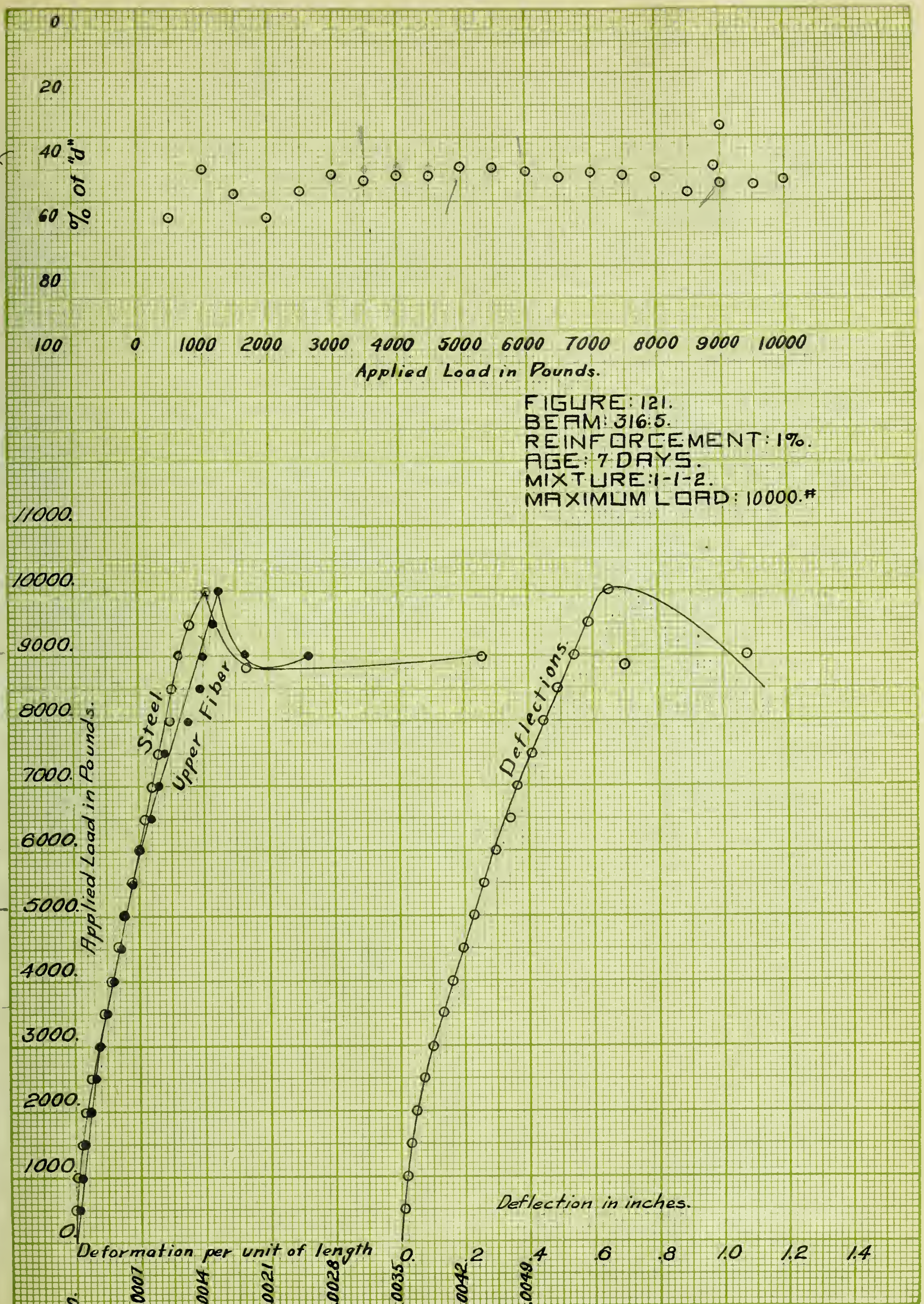
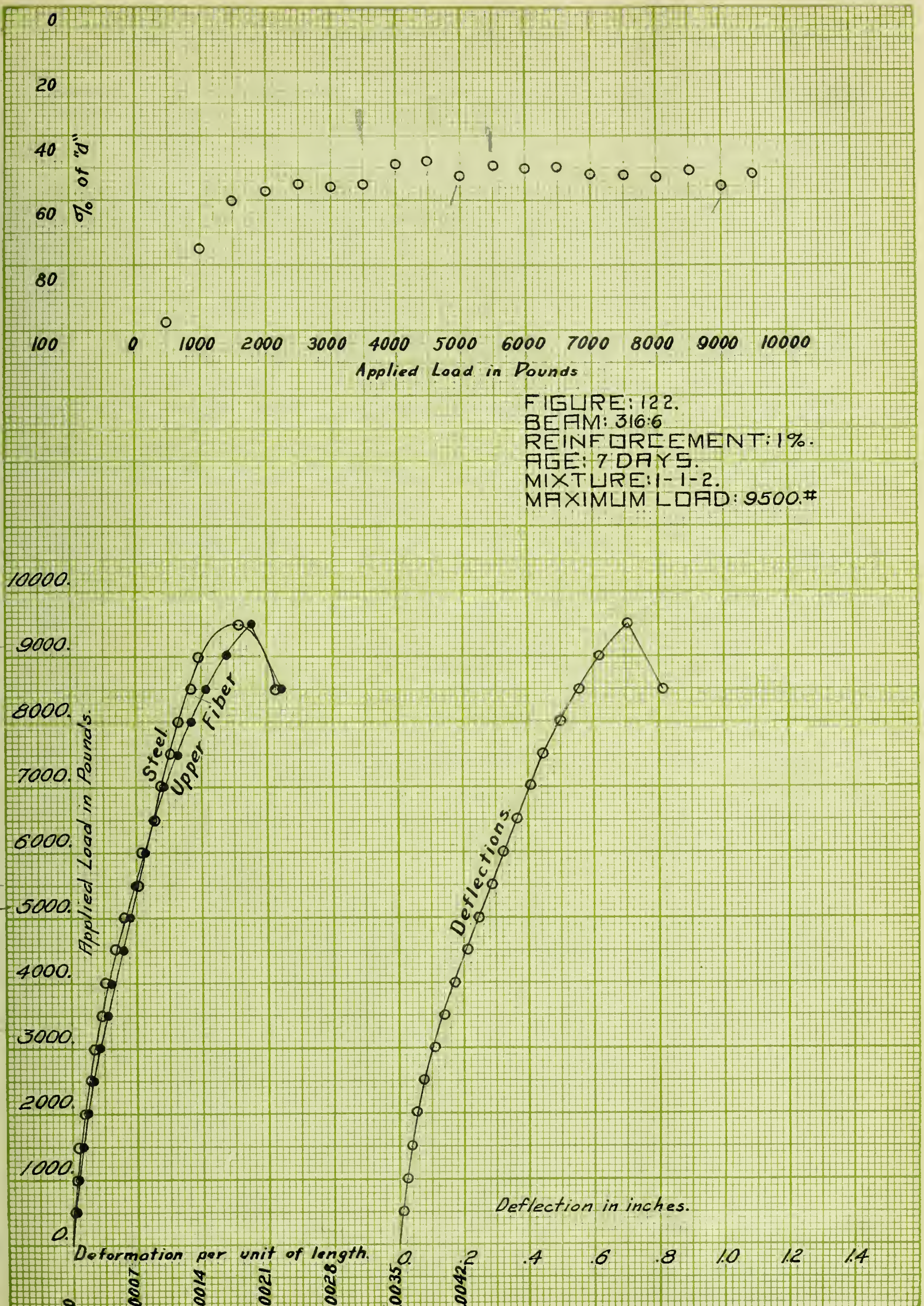
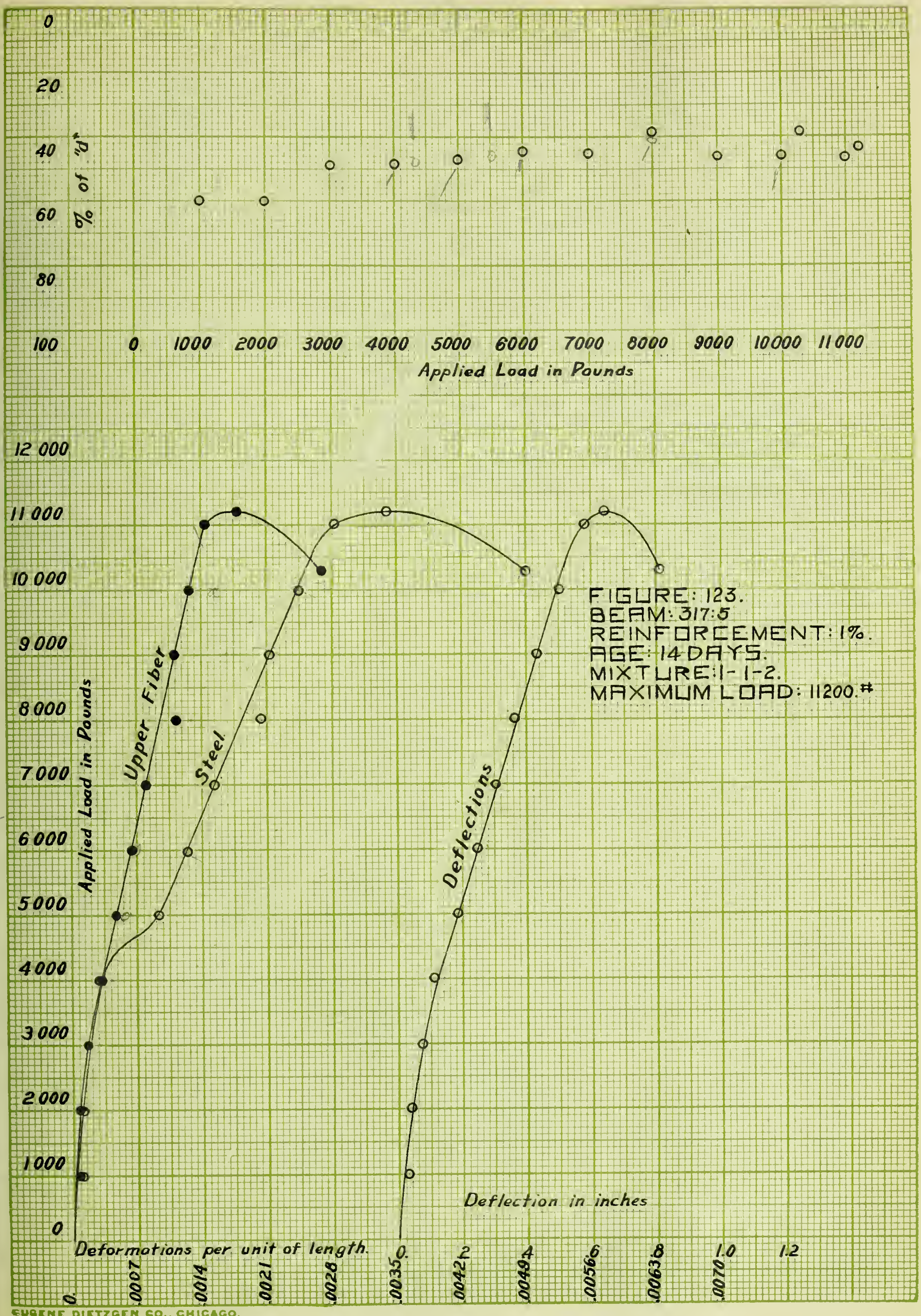


FIGURE: 120.
BEAM: 315:5
REINFORCEMENT: 1%.
AGE: 4 DAYS.
MIXTURE: 1-2-4.
MAXIMUM LOAD: 2550.#


0
20
40
60
80
100
% of "d"
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Applied Load in Pounds.
FIGURE: 121.
BEAM: 316:5.
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-1-2.
MAXIMUM LOAD: 10000.#
11000.
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Steel.
Upper Fiber.
Deflections.
Deflection in inches.
Deformation per unit of length
0.
.0007
.0014
.0021
.0028
.0035
.0042
.0049
0.
.2
.4
.6
.8
1.0
1.2
1.4


0
20
40
60
80
100
% of "d"
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Applied Load in Pounds
FIGURE: 122.
BEAM: 316.6
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-1-2.
MAXIMUM LOAD: 9500.#
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds.
Steel
Upper Fiber
Deflections
Deflection in inches.
Deformation per unit of length.
0
.0007
.0014
.0021
.0028
.0035
.0042
0.
.2
.4
.6
.8
1.0
1.2
1.4


0
20
40
60
80
100
% of "d"
0. 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000
Applied Load in Pounds
12 000
11 000
10 000
9 000
8 000
7 000
6 000
5 000
4 000
3 000
2 000
1 000
0
Applied Load in Pounds
Upper Fiber
Steel
Deflections
FIGURE: 123.
BEAM: 317:5
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-1-2.
MAXIMUM LOAD: 11200.#
Deflection in inches
Deformations per unit of length.
0. .0007 .0014 .0021 .0028 .0035 .0042 .0049 .0056 .0063 .0070
0. .2 .4 .6 .8 1.0 1.2
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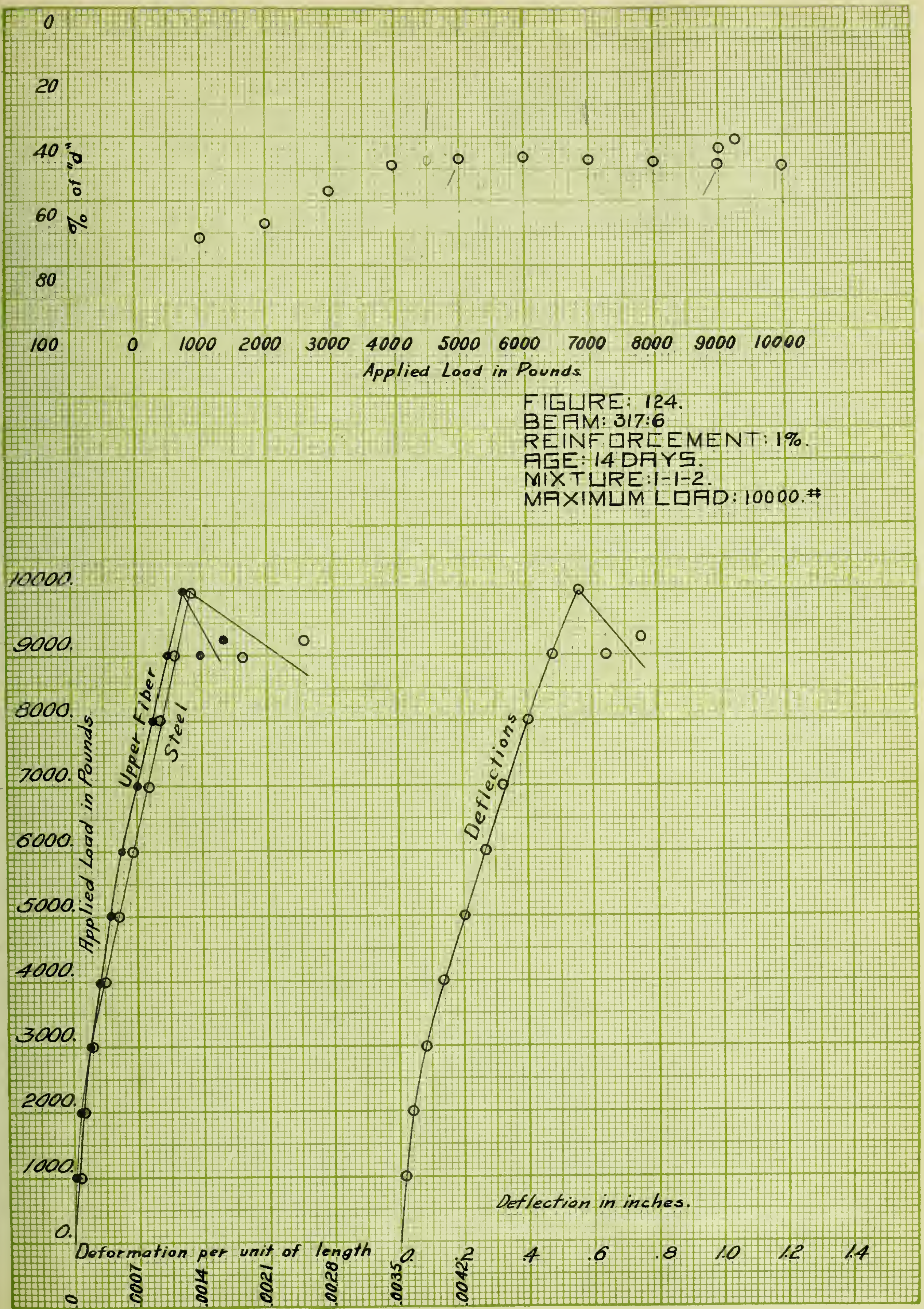


0
20
40
60
80
100
% of "d"
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Applied Load in Pounds
FIGURE: 124.
BEAM: 317:6
REINFORCEMENT: 1%.
AGE: 14 DAYS.
MIXTURE: 1-1-2.
MAXIMUM LOAD: 10000.#
10000.
9000.
8000.
7000.
6000.
5000.
4000.
3000.
2000.
1000.
0.
Applied Load in Pounds
Upper Fiber
Steel
Deflections
Deflection in inches.
Deformation per unit of length
0
.0007
.0014
.0021
.0028
.0035
.0042
0.
.2
.4
.6
.8
1.0
1.2
1.4

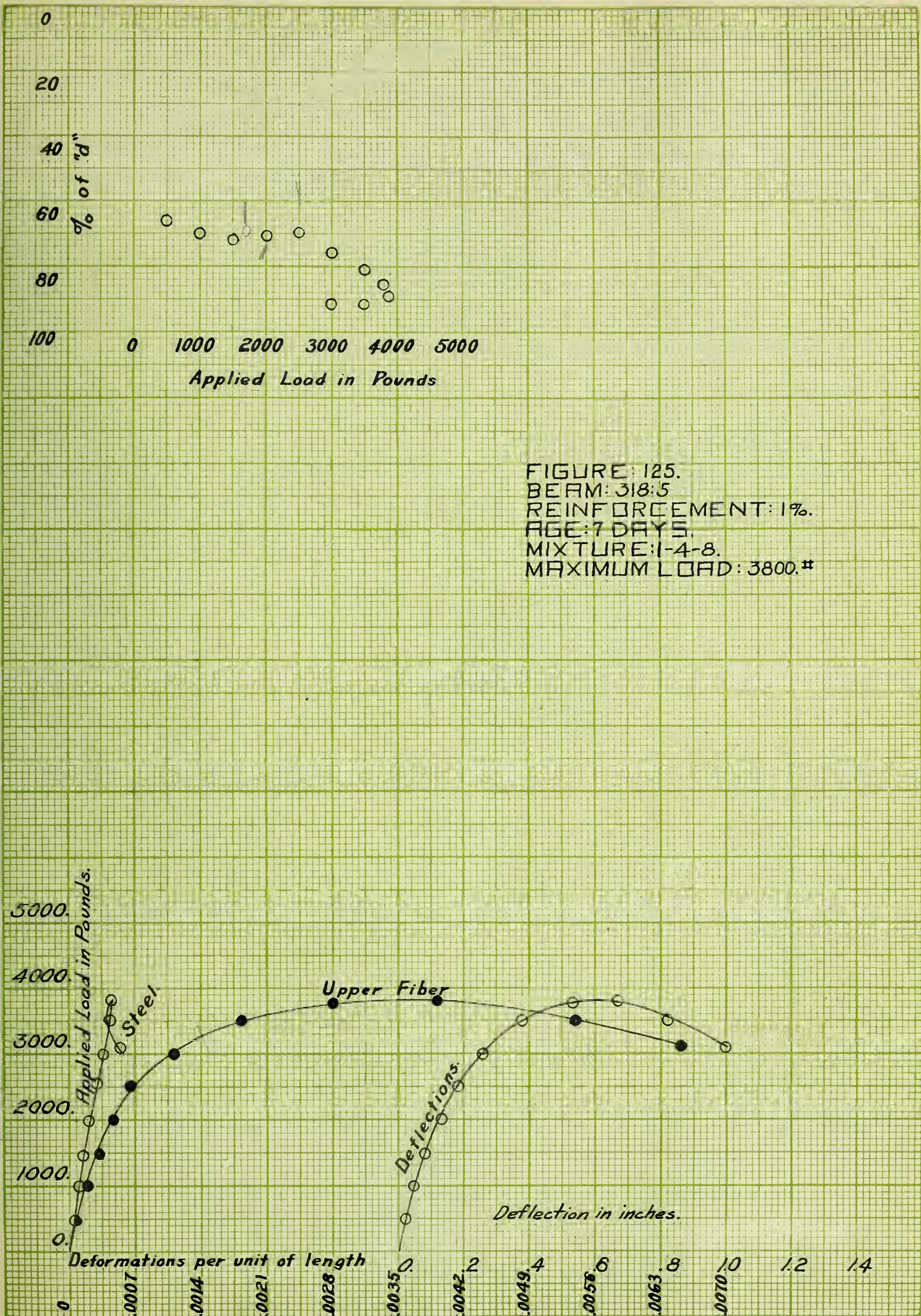


FIGURE: 125.
BEAM: 318:5
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-4-8.
MAXIMUM LOAD: 3800.#

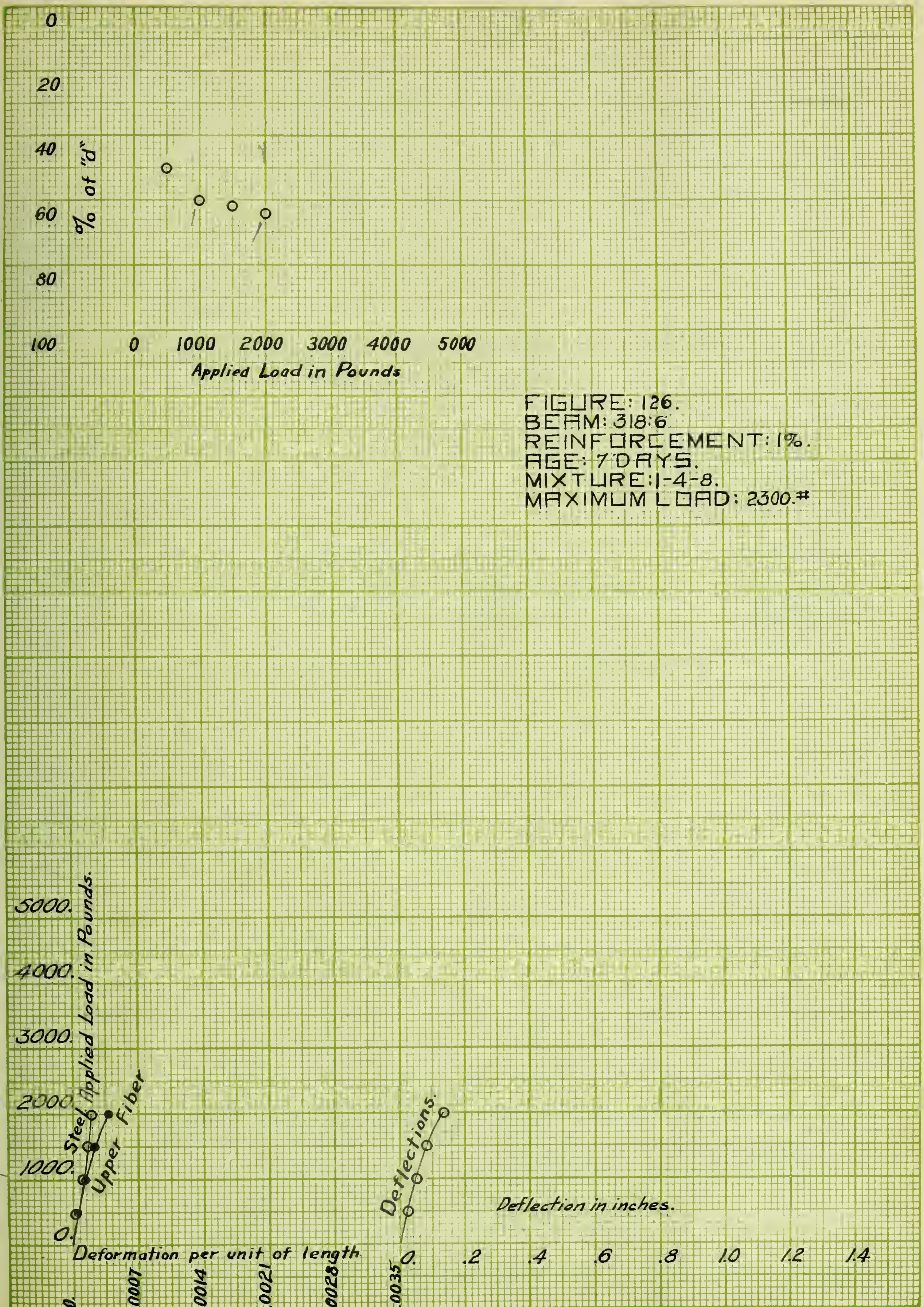
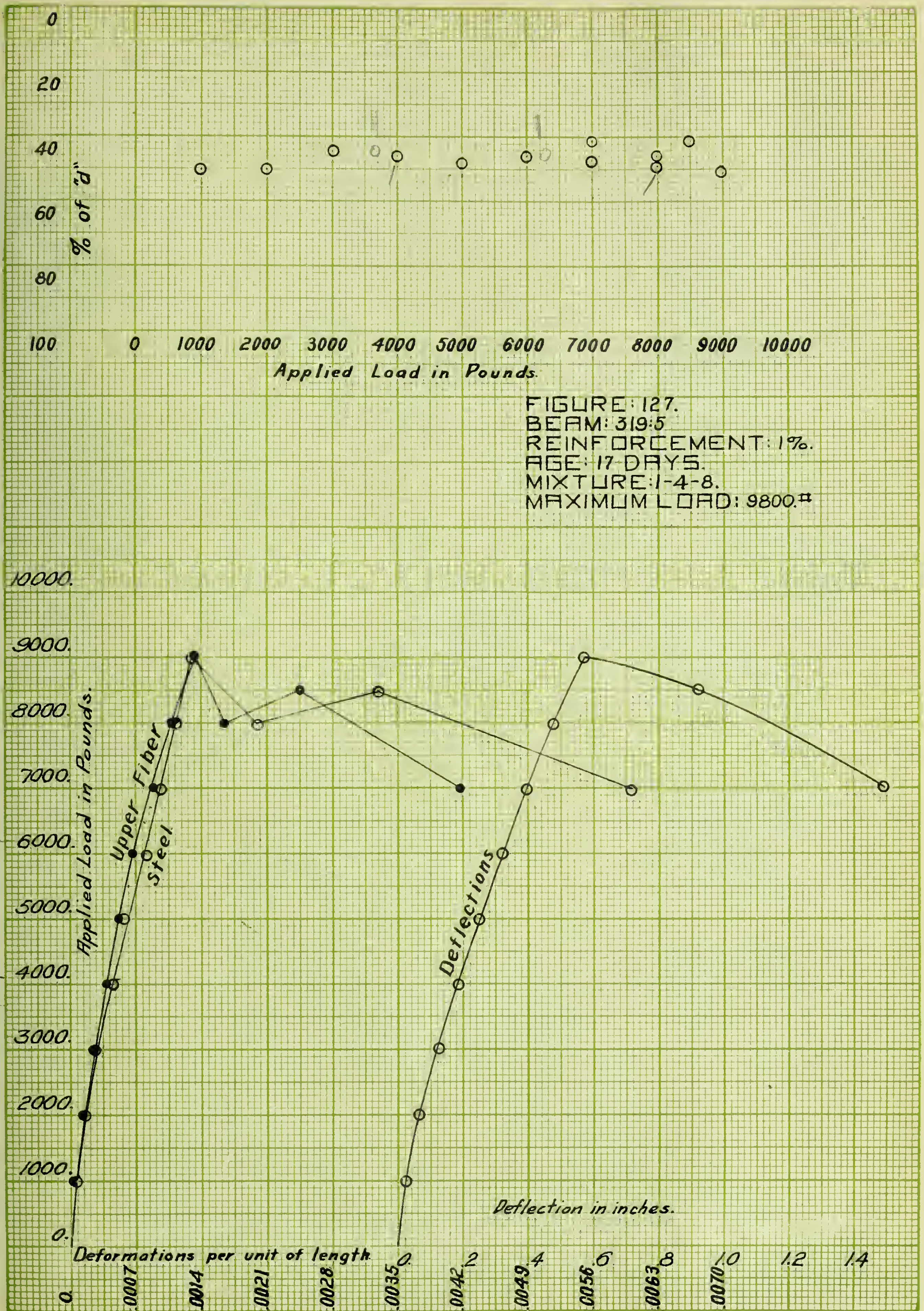


FIGURE: 126.
BEAM: 318:6
REINFORCEMENT: 1%.
AGE: 7 DAYS.
MIXTURE: 1-4-8.
MAXIMUM LOAD: 2300.#



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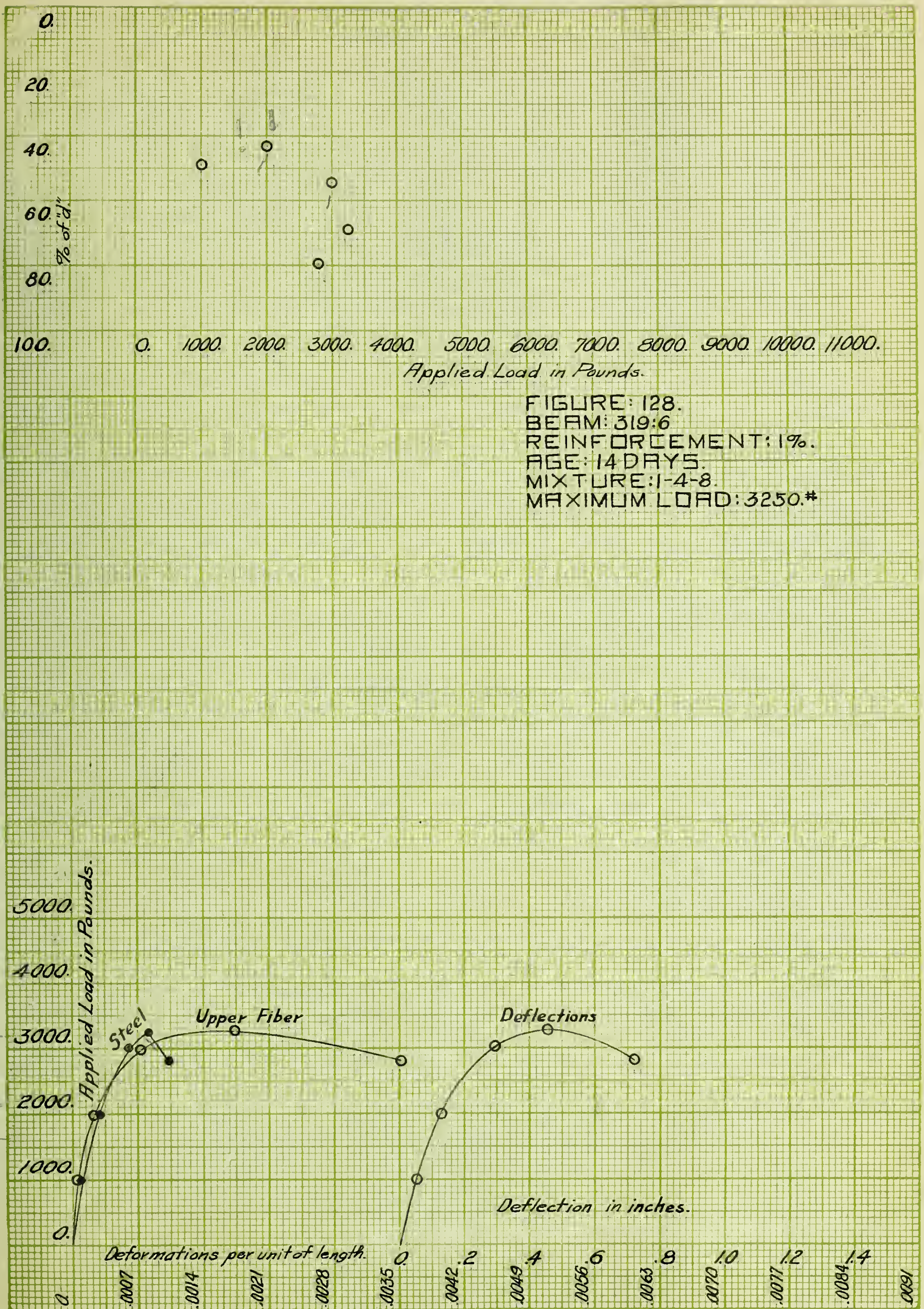

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PART VIII.

ORIGINAL DATA.

Table 1. Beam #311-1 7 Day Test.

8"×10"×12'-0' Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection.		Extensometer.				Remarks.
	R.	L.	#1.	#2.	#3.	#4.	
0.	2.46	1.69	0.	0.	0.	0.	
500.	2.47	1.70	.0038	.0030	.0038	.0025	
1000.	2.48	1.71	.0072	.0058	.0051	.0054	
1500.	2.52	1.76	.0159	.0128	.0148	.0119	
2000.	2.56	1.81	.0281	.0222	.0278	.0209	
2500.	2.62	1.90	.0500	.0359	.0505	.0340	
3000.	2.78	2.02	.0881	.0558	.0888	.0538	
3370.	3.14	2.43	.2320	.1205	.2410	.1135	
3370.	3.28	2.54	.2838	.1400	.2920	.1360	First signs of compression.
3100.	—	2.82	.3920	.1808	.4200	.1795	
2850.	—	3.00	.4450	.2120	.4820	.2250	
2480.	—	3.02	.4690	.2260	.5280	.2150	Failed by compression.

Table 2. Beam #311-2. 7 Day Test.

8"×10"×12'-0" Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	1.98	2.38	0.	0.	0.	0.	
500.	2.00	2.40	.0025	.0026	.0020	.0026	
1000.	2.02	2.42	.0055	.0054	.0052	.0053	
1500.	2.03	2.44	.0101	.0097	.0098	.0098	
2000.	2.06	2.47	.0168	.0158	.0165	.0160	
2500.	2.10	2.51	.0252	.0231	.0250	.0240	
3000.	2.14	2.56	.0335	.0302	.0335	.0301	
3500.	2.20	2.61	.0440	.0389	.0441	.0400	
4000.	2.26	2.66	.0569	.0485	.0571	.0491	
4500.	2.32	2.73	.0740	.0600	.0759	.0612	
5000.	2.42	2.84	.1040	.0758	.1060	.0760	
5300.	2.54	2.96	.1400	.0930	.1600	.0940	
5250.	2.68	3.10	.1920	.1115	.1932	.1110	
5000.	2.78	3.22	.2465	.1319	.2477	.1330	First sign of compression.
4000.	3.12	—	.3990	.1858	.4021	.1870	Failed by compression.

Table 3. Beam #311-3. 7 Day Test.

8"×10"×12'-0" Span. Mixture: 1-2-4.

Load.	Deflection R.	L.	Extensometer #1.	#2.	#3.	#4.	Remarks.
0.	1.10	1.61	0.	0.	0.	0.	
500.	1.10	1.62	.0018	.0021	.0025	.0028	
1000.	1.12	1.64	.0056	.0055	.0071	.0070	
1500.	1.15	1.66	.0108	.0098	.0125	.0124	
2000.	1.17	1.69	.0168	.0156	.0194	.0188	
2500.	1.22	1.73	.0243	.0222	.0283	.0265	
3000.	1.26	1.77	.0325	.0290	.0376	.0341	
3500.	1.30	1.82	.0435	.0368	.0483	.0422	
4000.	1.36	1.87	.0540	.0452	.0610	.0518	
4500.	1.42	1.93	.0688	.0555	.0774	.0626	
5000.	1.50	2.00	.0883	.0682	.0989	.0755	
5500.	1.58	2.10	.1147	.0838	.1280	.0910	
6000.	1.74	2.27	.1675	.1120	.1856	.1210	Crushing at 5800.# 3" N. of S. Ext. on left.
5900.	1.97	2.46	.2380	.1475	.2680	.1670	Failed by tension.

Table 4. Beam #311-5. 7 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0	0.48	0.40	.0	0	0	0	
500.	0.49	0.41	.0045	.0038	.0039	.0035	
1000.	0.53	0.44	.0120	.0095	.0101	.0075	
1500.	0.59	0.50	.0232	.0108	.0209	.0156	
2000.	0.64	0.57	.0414	.0300	.0380	.0260	
2500.	0.74	0.70	.0685	.0476	.0685	.0435	
2950.	1.08	0.90	.1320	.0875	.1550	.0875	
2860.	1.22	1.18	.1535	.1320	.2650	.1245	First signs of compression: 6" N. of center.
2680.	1.50	1.34	.1518	.1622	.3530	.1725	Failed by compression.

Table 5. Beam #311-6. 7 Day Test.

8"x10"x12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection.		Extensometer.				Remarks.
	R.	L.	#1.	#2.	#3.	#4.	
0.	1.47	2.03	0.	0.	0.	0.	
500.	1.50	2.04	.0030	.0025	.0035	.0038	
1000.	1.50	2.06	.0053	.0047	.0061	.0062	
1500.	1.52	2.07	.0071	.0100	.0081	.0100	
2000.	1.54	2.10	.0122	.0153	.0127	.0152	
2500.	1.58	2.13	.0210	.0176	.0210	.0169	
3000.	1.60	2.16	.0210	.0223	.0268	.0226	
3500.	1.64	2.20	.0263	.0275	.0336	.0279	
4000.	1.68	2.23	.0330	.0338	.0414	.0390	
4500.	1.72	2.28	.0403	.0398	.0448	.0460	
5000.	1.76	2.31	.0480	.0460	.0509	.0535	* Broke very suddenly at 6550.#
5500.	1.81	2.37	.0570	.0535	.0707	.0615	Failed by diagonal tension.
6000.	1.88	2.42	.0690	.0616	.0839	.0700	
6500.	1.96	2.51	.0878	.0721	.1039	.0810	

Table 6. Beam #311-7. 7 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0	0.68	0.77	0.	0.	0.	0.	
500.	0.68	0.79	.0030	.0021	.0020	.0018	
1000.	0.70	0.80	.0067	.0042	.0054	.0048	
1500.	0.73	0.83	.0115	.0085	.0103	.0091	
2000.	0.78	0.86	.0185	.0147	.0165	.0156	
2500.	0.81	0.90	.0252	.0206	.0229	.0216	
3000.	0.85	0.94	.0335	.0272	.0304	.0280	
3500.	0.90	0.98	.0425	.0341	.0387	.0350	
4000.	0.95	1.04	.0540	.0421	.0493	.0435	
4500.	1.00	1.10	.0683	.0508	.0620	.0522	
5000.	1.11	1.23	.0950	.0652	.0866	.0671	
5150.	1.20	1.33	.1337	.0812	.1227	.0840	First sign of compression.
4500.	1.40	1.49	.2130	.1111	.1992	.1135	Failed by compression.

Table 7. Beam #311-8. 7 Day Test.

8"x10"x12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	1.30	0.88	0.	0.	0.	0.	
500.	1.30	0.90	.0030	.0040	.0020	.0030	
1000.	1.32	0.92	.0065	.0070	.0040	.0067	
1500.	1.34	0.94	.0107	.0105	.0085	.0090	
2000.	1.37	0.97	.0168	.0150	.0150	.0145	
2500.	1.41	1.00	.0230	.0215	.0220	.0208	
3000.	1.44	1.03	.0320	.0285	.0310	.0279	
3500.	1.50	1.10	.0430	.0365	.0425	.0357	
4000.	1.54	1.13	.0555	.0451	.0557	.0444	
4500.	1.62	1.20	.0759	.0580	.0770	.0564	
5000.	1.73	1.32	.1090	.0750	.1100	.0734	
5300.	1.91	1.50	.1800	.1068	.1820	.1035	First signs of compression.
4750.	2.02	1.62	.2280	.1240	.2290	.1208	Failed by compression.

Table 8. Beam #312-1. 14 Day Test.

8"×10"×12'-0" Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection.		Extensometer.				Remarks.
	R.	L.	#1.	#2.	#3.	#4.	
0.	1.47	0.78	0.	0.	0.	0.	
500.	1.48	0.79	.0021	.0020	.0016	.0027	
1000.	1.49	0.80	.0053	.0045	.0042	.0040	
1500.	1.51	0.81	.0088	.0075	.0072	.0065	
2000.	1.53	0.82	.0133	.0125	.0116	.0103	
2500.	1.55	0.85	.0188	.0168	.0170	.0158	
3000.	1.58	0.90	.0254	.0265	.0238	.0225	
3500.	1.62	0.92	.0312	.0299	.0309	.0292	
4000.	1.65	0.96	.0390	.0359	.0376	.0355	
4500.	1.69	1.00	.0471	.0429	.0453	.0428	
5000.	1.72	1.05	.0558	.0498	.0538	.0500	
5500.	1.77	1.08	.0653	.0572	.0628	.0574	
6000.	1.82	1.11	.0759	.0646	.0728	.0651	
6500.	1.86	1.18	.0880	.0730	.0845	.0739	
7000.	1.92	1.22	.1028	.0823	.0979	.0833	
7500.	1.98	1.30	.1188	.0921	.1140	.0936	
8000.	2.07	1.38	.1429	.1048	.1352	.1063	Crack appeared 1½" N. inside load on left: also 2½" inside N. load on right. Signs of crushing on top above crack. Failed by compression.
8500.	2.20	1.50	.1820	.1236	.1712	.1259	
8750.	2.37	1.68	.2440	.1502	.2292	.1536	
7900.	2.43	1.74	.2630	.1525	.2458	.1610	

Table 9. Beam #312-2. 14 Day Test.

8"×10"×12'0" Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection. R.	L.	Extensometer. #1.	#2.	#3.	#4.	Remarks.
0.	0.50	0.70	0.	0.	0.	0.	
1000.	0.52	0.72	.0048	.0037	.0052	.0040	
2000.	0.56	0.76	.0105	.0087	.0117	.0101	
3000.	0.60	0.80	.0207	.0184	.0228	.0214	
4000.	0.66	0.86	.0323	.0302	.0357	.0348	
5000.	0.74	0.94	.0460	.0430	.0504	.0491	
6000.	0.80	1.02	.0610	.0560	.0670	.0638	
7000.	0.90	1.10	.0793	.0700	.0868	.0792	
8000.	1.01	1.21	.1060	.0875	.1140	.0989	
9000.	1.16	1.36	.1460	.1115	.1570	.1252	
9250.	1.25	1.45	.1720	.1310	.1900	.1500	First signs failure.
8000.	1.33	1.53	.1935	.1565	.2150	.1758	Failed by compression.

Table 10. Beam #312-3. 14 Day Test.

8"×10"×12'-0" Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection. R.	L.	Extensometer. #1.	#2.	#3.	#4.	Remarks.
0.	0.58	0.35	0.	0.	0.	0.	
1000.	0.60	0.38	.0047	.0035	.0040	.0090	
2000.	0.64	0.41	.0130	.0108	.0123	.0173	
3000.	0.70	0.47	.0252	.0221	.0237	.0292	
4000.	0.77	0.55	.0353	.0389	.0369	.0430	
5000.	0.84	0.61	.0516	.0475	.0508	.0577	
6000.	0.93	0.71	.0660	.0618	.0678	.0747	
7000.	1.03	0.81	.0816	.0773	.0885	.0958	
8000.	1.14	0.92	.1000	.0955	.1172	.1228	
9000.	1.33	1.11	.1340	.1322	.1702	.1744	Crack: 1" S. of N. load on bottom.
8000.	1.47	1.26	.1867	.1825	.2222	.2242	Failed by tension.

Table 11. Beam #312-5. 14 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.50	1.36	0.	0.	0.	0.	
1000.	0.53	1.40	.0060	.0062	.0053	.0059	
2000.	0.58	1.44	.0159	.0156	.0158	.0159	
3000.	0.63	1.50	.0278	.0268	.0278	.0279	
4000.	0.70	1.58	.0418	.0385	.0426	.0409	
5000.	0.80	1.65	.0588	.0520	.0600	.0550	
6000.	0.88	1.76	.0804	.0675	.0822	.0716	
7000.	1.00	1.90	.1119	.0870	.1140	.0922	6700.# Small crack 10" N. of S. load R.
8000.	1.24	2.10	.1900	.1255	.1920	.1235	7500.# Crushed on top.
7000.	1.36	2.28	.2560	.1475	.2582	.1548	Failed by compression.

Table 12. Beam #312-6. 14 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection R.	Deflection L.	Extensometer #1.	Extensometer #2.	Extensometer #3.	Extensometer #4.	Remarks.
0.	1.99	0.74	0.	0.	0.	0.	
1000.	2.02	0.76	.0058	.0057	.0052	.0045	
2000.	2.06	0.80	.0158	.0152	.0147	.0138	
3000.	2.12	0.87	.0286	.0297	.0279	.0275	
4000.	2.19	0.94	.0438	.0453	.0427	.0422	
5000.	2.27	1.02	.0610	.0596	.0596	.0576	
6000.	2.37	1.11	.0833	.0774	.0812	.0754	
7000.	2.49	1.23	.1145	.0991	.1113	.0972	
8000.	2.70	1.44	.1808	.1395	.1732	.1440	Crushing appeared on top.
7200.	2.81	1.56	.2250	.1716	.2152	.1690	Failed by compression.
6500.	3.13	1.86	.3530	.2680	.3375	.2675	

Table 13. Beam #312-7. 14 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	#2.	#3.	#4.	Remarks.
0.	0.36	0.52	0.	0.	0.	0.	
1000.	0.38	0.54	.0040	.0046	.0042	.0050	
2000.	0.42	0.58	.0100	.0112	.0100	.0115	
3000.	0.48	0.63	.0200	.0182	.0196	.0230	
4000.	0.54	0.70	.0310	.0336	.0308	.0355	
5000.	0.60	0.77	.0445	.0470	.0451	.0510	
6000.	0.68	0.84	.0572	.0585	.0573	.0625	
7000.	0.78	0.93	.0748	.0727	.0748	.0775	
7700.	0.87	1.02	.0870	.0812	.0868	.0860	Failed by diagonal tension.

Table 14. Beam #313-5. 24 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.88	0.52	0.	0.	0.	0.	
1000.	0.90	0.54	.0048	.0032	.0046	.0038	
2000.	0.93	0.57	.0115	.0091	.0122	.0095	
3000.	1.00	0.62	.0215	.0190	.0237	.0198	
4000.	1.06	0.68	.0335	.0309	.0365	.0315	
5000.	1.12	0.75	.0445	.0427	.0493	.0438	
6000.	1.20	0.82	.0565	.0550	.0635	.0580	
7000.	1.28	0.90	.0705	.0673	.0786	.0715	
8000.	1.36	0.97	.0855	.0796	.0945	.0850	
9000.	1.44	1.06	.1045	.0959	.1163	.1040	
9500.	1.55	1.17	.1305	.1262	.1471	.1375	Tension cracks first seen: then
8500.	1.82	1.44	.2000	.2240	.2318	.2375	Compression. Failed by tension.

Table 15. Beam #313-6. 77. Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	L.	Extensometer. #1.	#2.	#3.	#4.	Remarks.
0.	1.28	1.30	0.	0.	0.	0.	
1000.	1.30	1.31	.0038	.0030	.0040	.0040	
2000.	1.31	1.34	.0094	.0088	.0099	.0103	
3000.	1.33	1.37	.0160	.0177	.0171	.0195	
4000.	1.39	1.42	.0250	.0268	.0274	.0302	
5000.	1.43	1.47	.0338	.0360	.0380	.0421	
6000.	1.50	1.53	.0425	.0480	.0457	.0532	
7000.	1.55	1.58	.0507	.0573	.0544	.0633	
8000.	1.60	1.64	.0594	.0676	.0640	.0743	
9000.	1.65	1.70	.0677	.0775	.0732	.0850	
10000.	1.71	1.75	.0765	.0880	.0828	.0960	
11350.	1.78	1.80	.0858	.0990	.0937	.1080	Crack shown on bottom.
11350.	1.85	1.86	.0990	.1285	.1072	.1380	Failure.
10000.	1.90	1.94	.1160	.1620	.1254	.1728	Failed by tension.

Table 16. Beam #314-1. 63 Day Test.

8"×10"×12'-0" Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	-0.06	0.74	0.	0.	0.	0.	
1000.	-0.04	0.75	.0041	.0039	.0034	.0031	
2000.	-0.02	0.77	.0089	.0081	.0078	.0068	
3000.	0.	0.80	.0148	.0135	.0127	.0116	
4000.	0.03	0.83	.0223	.0218	.0190	.0184	
5000.	0.08	0.88	.0320	.0336	.0281	.0295	
6000.	0.14	0.94	.0420	.0416	.0375	.0419	
7000.	0.18	0.99	.0505	.0571	.0458	.0520	
8000.	0.26	1.05	.0608	.0693	.0557	.0642	
9000.	0.30	1.10	.0702	.0800	.0644	.0748	
10000.	0.36	1.16	.0795	.0902	.0733	.0850	
11000.	0.42	1.22	.0893	.1010	.0826	.0955	10500.# Fine vertical cracks appeared
11800.	0.52	1.32	.1110	.1415	.1031	.1339	on both sides at center middle third.
10700.	0.69	1.48	.1445	.2100	.1368	.2040	Failed by tension.

Table 17. Beam #314-2. 63 Day Test.

8"×10"×12'-0" Span. C.A.A. Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.29	1.12	0.	0.	0.	0.	
1000.	0.31	1.14	.0040	.0048	.0048	.0056	
2000.	0.34	1.19	.0129	.0125	.0125	.0131	
3000.	0.38	1.22	.0193	.0205	.0200	.0215	
4000.	0.42	1.29	.0289	.0300	.0298	.0319	
5000.	0.50	1.33	.0380	.0408	.0398	.0422	
6000.	0.56	1.40	.0478	.0508	.0498	.0530	
7000.	0.60	1.45	.0573	.0612	.0600	.0624	
8000.	0.68	1.50	.0680	.0720	.0709	.0745	
9000.	0.76	1.58	.0796	.0835	.0835	.0862	
10000.	0.83	1.64	.0901	.0970	.0940	.0960	Failed by diagonal tension.

Table 18. Beam #314-5. 67 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	1.12	1.38	0.	0.	0.	0.	
1000.	1.13	1.40	.0069	.0055	.0050	.0050	
2000.	1.14	1.42	.0138	.0109	.0111	.0094	
3000.	1.15	1.45	.0223	.0192	.0192	.0176	
4000.	1.19	1.50	.0326	.0297	.0285	.0260	
5000.	1.23	1.56	.0430	.0410	.0385	.0364	String on right side broke.
6000.	—	1.62	.0538	.0472	.0488	.0472	
7000.	—	1.68	.0640	.0635	.0590	.0575	
8000.	—	1.74	.0750	.0748	.0695	.0688	
9000.	—	1.80	.0861	.0865	.0810	.0800	
10000.	—	1.88	.0978	.0980	.0972	.0915	
10850.	—	1.92	.1108	.1152	.1040	.1045	
9500.	—	2.02	.1340	.1580	.1270	.1468	Failed by tension.

Table 19. Beam #314-6. 63 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection.		Extensometer.				Remarks.
	R.	L.	#1.	#2.	#3.	#4.	
0.	1.88	0.91	0.	0.	0.	0.	
1000.	1.89	0.94	.0046	.0038	.0041	.0039	
2000.	1.91	0.96	.0089	.0098	.0104	.0100	
3000.	1.95	1.00	.0139	.0175	.0174	.0178	
4000.	2.00	1.06	.0221	.0272	.0257	.0272	
5000.	2.03	1.10	.0311	.0380	.0348	.0377	
6000.	2.10	1.16	.0393	.0474	.0434	.0472	
7000.	2.18	1.22	.0487	.0508	.0530	.0508	
8000.	2.20	1.28	.0578	.0681	.0626	.0683	
9000.	2.32	1.34	.0680	.0788	.0730	.0791	
10000.	2.34	1.40	.0776	.0890	.0830	.0894	
11000.	2.42	1.48	.0893	.1005	.0948	.1010	
11300.	2.50	1.54	.1350	.1300	.1100	.1330	
10000.	2.58	1.62.	.1480	.1580	.1260	.1610	Failed by tension.

Table 20. Beam #315-5. 4 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-2-4.

Load.	Deflection R.	Deflection L.	Extensometer #1.	Extensometer #2.	Extensometer #3.	Extensometer #4.	Remarks.
0.	0.15	0.25	0.	0.	0.	0.	
250.	0.16	0.26	.0042	.0020	.0028	.0034	
500.	0.17	0.28	.0084	.0049	.0070	.0063	
750.	0.20	0.30	.0140	.0085	.0125	.0100	
1000.	0.23	0.32	.0211	.0130	.0198	.0148	
1250.	0.25	0.36	.0294	.0185	.0280	.0198	
1500.	0.29	0.40	.0392	.0235	.0375	.0253	
1750.	0.35	0.45	.0583	.0345	.0555	.0360	
2000.	0.41	0.52	.0772	.0428	.0750	.0448	
2250.	0.52	0.61	.1063	.0580	.1038	.0581	
2500.	0.73	0.82	.1830	.0874	.1795	.0894	
2550.	0.91	1.00	.2608	.1185	.2580	.1190	
2450.	1.11	1.18	.3312	.1438	.3290	.1442	First signs compression on top.
2300.	1.28	1.32	.4074	.1711	.4050	.1703	Failed by compression.

Table 21. Beam #316-5. 7 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-1-2.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.64	0.66	0.	0.	0.	0.	
500.	0.65	0.67	.0028	.0026	.0028	.0018	
1000.	0.66	0.68	.0049	.0045	.0050	.0038	
1500.	0.67	0.69	.0080	.0070	.0080	.0062	
2000.	0.69	0.70	.0111	.0095	.0112	.0092	
2500.	0.72	0.72	.0168	.0152	.0169	.0149	
3000.	0.74	0.76	.0219	.0208	.0228	.0209	
3500.	0.77	0.80	.0274	.0265	.0285	.0268	
4000.	0.80	0.82	.0332	.0327	.0349	.0333	
4500.	0.84	0.85	.0394	.0389	.0412	.0400	
5000.	0.87	0.88	.0448	.0441	.0458	.0452	
5500.	0.90	0.91	.0505	.0502	.0535	.0515	
6000.	0.94	0.96	.0572	.0562	.0600	.0575	
6500.	0.98	1.01	.0647	.0630	.0674	.0643	
7000.	1.01	1.02	.0720	.0695	.0752	.0710	
7500.	1.05	1.07	.0798	.0760	.0830	.0776	
8000.	1.09	1.10	.0880	.0828	.0912	.0845	
8500.	1.14	1.14	.0964	.0890	.1100	.0910	
9000.	1.18	1.20	.1068	.0968	.1150	.0994	
9500.	1.23	1.24	.1168	.1048	.1209	.1070	Crack appeared 7" inside S. load on right.
10000.	1.28	1.31	.1281	.1250	.1332	.1157	Failed by tension in steel.
8840.	1.34	1.35	.1505	.1488	.1568	.1551	
9000.	1.72	1.73	.1984	.2965	.2865	.3280	Crushing on top above first crack.

Table 22. Beam #316-6. 7 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-1-2.

Load.	Deflection. R.	L.	Extensometer. #1.	#2.	#3.	#4.	Remarks.
0.	1.23	1.10	0.	0.	0.	0.	
500.	1.24	1.11	.0020	.0014	.0022	.0016	
1000.	1.26	1.12	.0048	.0033	.0051	.0040	
1500.	1.27	1.13	.0075	.0055	.0082	.0067	
2000.	1.28	1.15	.0110	.0088	.0120	.0107	
2500.	1.31	1.18	.0160	.0140	.0176	.0164	
3000.	1.35	1.20	.0240	.0206	.0242	.0236	
3500.	1.37	1.24	.0276	.0272	.0305	.0300	
4000.	1.40	1.27	.0336	.0337	.0372	.0370	
4500.	1.45	1.30	.0398	.0401	.0440	.0440	
5000.	1.48	1.34	.0512	.0471	.0514	.0511	
5500.	1.52	1.38	.0542	.0540	.0595	.0586	
6000.	1.55	1.42	.0618	.0610	.0679	.0660	
6500.	1.60	1.46	.0698	.0680	.0764	.0735	
7000.	1.64	1.50	.0785	.0754	.0854	.0812	
7500.	1.68	1.54	.0883	.0834	.0961	.0900	
8000.	1.74	1.60	.0993	.0922	.1085	.0991	Failed by tension.
8500.	1.80	1.65	.1110	.1010	.1205	.1090	
9000.	1.85	1.71	.1248	.1111	.1352	.1200	Cracked 18" S. of N. load. right side.
9500.	1.94	1.80	.1480	.1400	.1650	.1550	and 19" S. of N. load left side.
8500.	2.05	1.90	.1750	.1696	.1928	.1856	then crushed on top above cracks.

Table 23. Beam #317-5. 14 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-1-2.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.85	0.31	0.	0.	0.	0.	
1000.	0.88	0.34	.0068	.0063	.0073	.0068	
2000.	0.89	0.35	.0085	.0077	.0089	.0083	
3000.	0.92	0.38	.0140	.0149	.0149	.0144	
4000.	0.97	0.42	.0231	.0225	.0245	.0255	
5000.	1.04	0.48	.0337	.0344	.0351	.0390	
6000.	1.10	0.55	.0443	.0466	.0469	.0528	
7000.	1.16	0.61	.0550	.0578	.0575	.0649	
8000.	1.22	0.67	.0655	.0870	.0683	.0768	
9000.	1.28	0.74	.0778	.0802	.0804	.0895	
10000.	1.36	0.81	.0904	.0922	.0932	.1025	First crack appeared.
11000.	1.43	0.89	.1050	.1067	.1083	.1187	
11200.	1.50	0.94	.1180	.1285	.1208	.1410	Failed by tension.
10300.	1.66	1.12	.1580	.1909	.1659	.2010	

Table 24. Beam #317-6. 14 Day Test.

8"×10"×12'-0" Universal Cement. Mixture: 1-1-2.

	Deflection		Extensometer.				
Load.	R.	L.	#1.	#2.	#3.	#4.	Remarks.
0.	0.68	0.10	0.	0.	0.	0.	
1000.	0.69	0.12	.0034	.0028	.0030	.0026	
2000.	0.72	0.14	.0085	.0075	.0082	.0073	
3000.	0.75	0.18	.0150	.0138	.0145	.0138	
4000.	0.81	0.22	.0259	.0268	.0252	.0262	
5000.	0.88	0.30	.0356	.0385	.0358	.0379	
6000.	0.94	0.36	.0484	.0512	.0472	.0501	
7000.	1.00	0.41	.0605	.0632	.0588	.0620	
8000.	1.07	0.50	.0731	.0753	.0713	.0740	
9000.	1.15	0.57	.0877	.0883	.0853	.0866	Cracks R. and L. 9" N. of S. load point.
10000.	1.23	0.65	.1035	.1018	.1010	.1000	
9000.	1.31	0.73	.1258	.1385	.1232	.1377	Cracks R. and L. 12" S. of N. load point.
9250.	1.43	0.83	.1541	.1820	.1518	.1812	Failed by tension.

Table 25. Beam #318-5 7 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-4-8.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.56	1.40	0.	0.	0.	0.	
500.	0.58	1.42	.0070	.0038	.0036	.0035	
1000.	0.60	1.45	.0167	.0088	.0090	.0084	
1500.	0.64	1.48	.0281	.0152	.0169	.0152	
2000.	0.69	1.53	.0415	.0221	.0260	.0230	
2500.	0.73	1.58	.0605	.0307	.0340	.0321	
3000.	0.81	1.66	.0915	.0437	.0584	.0455	
3500.	0.94	1.78	.1470	.0630	.0939	.0635	
3750.	1.10	1.92	.2260	.0862	.1411	.0870	
3800.	1.23	2.06	.3050	.1100	.1940	.1060	
3500.	1.36	2.22	.3950	.1378	.2630	.1298	First signs of compression.
3100.	1.60	2.37	.4760	.1680	.3440	.1670	Failed by compression.

Table 26. Beam #318-6. 7 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-4-8.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.83	0.92	0.	0.	0.	0.	
500.	0.85	0.95	.0036	.0037	.0042	.0036	
1000.	0.88	0.97	.0088	.0081	.0099	.0082	
1500.	0.91	1.00	.0160	.0135	.0175	.0140	See photograph. #
2000.	0.97	1.05	.0267	.0206	.0280	.0215	Failed by diagonal tension.
2300.	——	——	——	——	——	——	Beam broke very suddenly.

Table 27. Beam #319-5. 17 Day Test.

8"×10"×12'-0" Span. Universal Cement. Mixture: 1-4-8.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.86	0.37	0.	0.	0.	0.	
1000.	0.88	0.40	.0048	.0050	.0038	.0040	
2000.	0.92	0.44	.0123	.0128	.0116	.0119	
3000.	0.98	0.50	.0229	.0248	.0218	.0238	
4000.	1.04	0.56	.0339	.0361	.0329	.0358	
5000.	1.11	0.61	.0452	.0442	.0442	.0470	
6000.	1.17	0.70	.0580	.0625	.0570	.0582	
7000.	1.25	0.78	.0730	.0768	.0712	.0722	
8000.	1.33	0.86	.0890	.0900	.0865	.0850	
9000.	1.43	0.95	.1090	.1072	.1062	.1000	
8000.	1.56	1.08	.1460	.1545	.1410	.1490	Cracked 7"S. of N load on right at 9800.# and 8"S. of N load on left.
8500.	1.78	1.30	.2100	.2435	.2025	.2390	
7000.	2.35	1.86	.3660	.4450	.3930	.4436	Failed by tension.

Table 28. Beam #319-6. 14 Day Test.

8"x10"x12'-0" Span. Universal Cement. Mixture: 1-4-8.

Load.	Deflection. R.	Deflection. L.	Extensometer. #1.	Extensometer. #2.	Extensometer. #3.	Extensometer. #4.	Remarks.
0.	0.82	0.23	0.	0.	0.	0.	
1000.	0.87	0.28	.0095	.0095	.0055	.0066	
2000.	0.95	0.37	.0320	.0224	.0064	.0222	
3000.	1.11	——	.0795	.0561	.0363	.0476	
3250.	1.28	——	.1485	.0869	.0972	.0781	
2800.	1.54	——	.2935	.1500	.2350	.1335	Failed by compression.